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SURGERY

For Students and Practitioners

BY

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CHAPTER XXVI

INJURIES OF THE SPINE

THE spinal cord is protected from injury in a most complete and efficacious manner (a) Its position between the bodies and the laminae with the spinous processes arising therefrom is itself mechanically advantageous, since, whether the spine is forcibly flexed or extended, the cord remains midway between the points of chief compression or extension, and hence in a position of rest (b) The buffer like action of the intervertebral discs, and the varying curves of the column, serve to distribute some part of any force that reaches it (c) There is ample space in the spinal canal, in which the cord with its membranes is slung by prolongations of dura mater around the issuing nerves, whilst the cord itself hangs loosely within the dura mater, suspended by the ligamenta denticulata, and surrounded by cerebrospinal fluid (d) The cord terminates, in an adult, at the lower border of the first lumbar vertebra, a spot well above the junction of the fixed base and the movable upper part, a point where the effect of jars and wrenches is mainly felt (e) Nature has moreover, introduced a whole series of buffers and other means of preventing shock to the spine when a person falls on his feet, e.g. the arches and elasticity of the foot, the changes in direction of the bones at each joint, the interarticular cartilages of the knee, etc

The parts of the spine most exposed to injury are those where a fixed and movable portion meet, e.g. the dorsi lumbar and the cervico-dorsal regions. Moreover, the upper part of the dorsal curve, which projects backwards, is relatively a weak spot, and fractures are not at all uncommon about the fourth dorsal vertebra. The close proximity of the head explains the frequency of lesions about the upper cervical regions

Sprains of the spine are very common accidents, a fact not to be wondered at when its complicated muscular and ligamentous arrangements are considered. They are produced by any sudden or unexpected movements, such as falls, especially from horseback, railway accidents, and the like. The injury affects most frequently mobile parts of the spine, e.g. the cervical and lumbar regions, and may be limited to either ligamentous or muscular structures, or may involve both. The resulting Signs are simply those of a severe but localized trauma, viz. pain, tenderness, and perhaps a little swelling or bruising, the subjective phenomena are much increased by movement, so that the spine is kept rigidly quiet. If only the posterior muscles or inter-spinous ligaments are involved, pain is elicited by flexion of the spine, as it puts these structures on the stretch; active extension is also pain-

ful but passive backward extension is painless. Similarly unilateral lesions are productive of pain on stretching the injured structures. If the trouble is limited to the external muscles and ligaments, no further consequences are likely to arise, but when the ligamenta subflava are lacerated and the spinal canal is thus opened, pressure symptoms may arise from blood finding its way into the canal outside the dura mater, leading possibly to a temporary or permanent paraplegia. Inflammation of the damaged fibrous tissues may extend to the meninges and cord and cause organic disease. Moreover in patients of a tuberculous temperament spinal caries may follow such injuries, syphilitic or malignant disease has also been known to ensue.

In the cervical region sprains may occur as a result of severe blows on the head causing rupture of the intertransverse ligaments and the displacement may be so great as to simulate dislocation. The head and neck are held immovable and rigid and there is often considerable loss of power, the patient being sometimes unable to lift the head spontaneously from the pillow. Sprains in the lumbar region are very common both as a consequence of overlifting when the quadratus lumborum is most likely to be affected and as a result of railway injuries when they are often associated with nervous symptoms (p. 797). The back is kept fixed and rigid, the patient being unable to turn or stoop without pain. Sometimes hæmaturia results from injuries in the lumbar region arising from an associated contusion of the kidneys.

Treatment.—The patient should be kept at rest and fomentations applied to the injured part. When the painful or inflammatory symptoms have disappeared, massage with stimulating liniments is needed. In the severer cases the individual should be kept in bed for six or eight weeks and in the cervical region some form of mechanical support may be subsequently necessary. The appearance of inflammatory symptoms involving the meninges calls for even greater care, the patient should then be kept as much as possible in the prone position and a spinal icebag applied. The onset of paraplegia due either to hæmorrhage or inflammatory exudation would raise the question of laminectomy (p. 804).

Penetrating Wounds of the Spine are fortunately uncommon in civil practice, being generally due to stabs with pointed instruments such as bayonets or to gunshot wounds. They occasionally result from falls, the unfortunate individual becoming impaled on a railing, branches of trees, etc. The symptoms produced are (a) those due to the wound in the soft parts which may also involve the peritoneal and pleural cavities or damage to some of the viscera in the neck; the vertebral artery is exposed to injury from this type of accident leading to serious hæmorrhage; (b) various forms of fracture, the cord being compressed by fragments of bone which have been driven inwards or by extravasated blood; (c) those due to laceration of the spinal membranes, e.g. loss of cerebro-spinal fluid or at a later date may determine the patient's death by setting up diffuse septic meningitis (p. 796) and (d) those due to wounds of the spinal

cord, which depend upon whether the cord is completely or incompletely divided, upon the level or segment of the lesion, and upon the actual area damaged in an incomplete division, thus a hemisection of the cord will produce the Brown Séquard syndrome (p 802). The effects of a total transverse lesion at different levels of the spine are given at p 799. Of course, the cord may escape entirely, nerve roots or trunks only being involved, and in the lumbar or sacral regions the mischief may be limited to the cauda equina.

Treatment consists in exploring thoroughly the wound under an anæsthetic, removing foreign bodies or displaced fragments of bone, and attempting to render it aseptic. Wounds of the vertebral artery or other structures are dealt with *secundum artem*, and special attention is naturally given to the cord and its membranes. Should the dura mater have been opened, and the cord have escaped injury, an attempt may be made to close the wound in the meninges, and the patient should subsequently be kept in the prone position and with the head low, so as to prevent, as far as possible, the escape of cerebro-spinal fluid. If the cord itself is divided or lacerated, it is useless trying to unite it, since its function in conducting impulses from the brain downwards is inevitably destroyed. Where, however, the cauda equina has been injured, it is perfectly justifiable to lay open the spinal canal to a sufficient extent to expose the divided nerve trunks, and then to suture them.

Fractures of the Spine.—The spine may be broken as the result of (a) *direct violence* e.g. a fall on the back over some projecting body, such as a carpenter's bench or a railing, or a blow on the back with a heavy stone or with a swinging baulk of wood, or a gunshot wound. This type of accident may involve any part of the spine, and excluding those arising from gunshot, is less frequent than the class next to be described. Of necessity, the spine breaks at the point struck, the posterior parts of the vertebræ are most likely to be damaged in this form of injury. (b) *Fractures* are also due to *indirect violence*, then usually occurring in the lower cervical or upper dorsal regions. They are caused by forcible acute flexion of the spine as by a fall downwards with the head doubled up, or by taking a 'header' in shallow water, or when a man, being driven under a bridge, omits to stoop, and so is caught between the arch and the cart or sometimes by the fall of a heavy weight on the back of the neck or shoulder. The spine may break across more or less cleanly at its weakest point, or the lesion may be limited to one or two bodies which are crushed and broken. The latter type (compression fracture) is often limited to the bodies, the former usually involves injury to the cord.

Fractures of the spine may be divided into two main classes, according to whether or not they are complete—that is, according to whether the continuity of the column is destroyed or not.

(A) **Incomplete Fractures** may be met with in various forms, and are most frequently due to direct violence.

(1) *Fracture of the Spinous Processes* rarely occurs except in the lower cervical or dorsal regions. In the upper cervical region the

spines are short and retracted to allow of extension of the head whilst in the lumbar they are also short but very strong. The fracture is almost always due to direct violence and is characterized by the signs of a local trauma together with great mobility, perhaps crepitus and irregularity in the line of the spines. The broken fragment is occasionally much depressed and may even cause paraplegia by being driven into the spinal cord.

(ii) *Fracture of the Laminae* is not an uncommon accident always resulting from direct violence. If only one lamina is broken the signs are not very distinct and cord symptoms are rare. When both laminae yield the posterior part of the neural arch carrying with it the spinous process is very likely to be depressed to a sufficient extent to compress the cord and give rise to paraplegia. Crepitus is often obtainable and a gap in the line of the spinous processes can usually be felt.

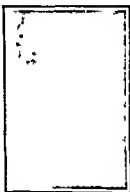


FIG. 48.—LATERAL SKIA-GRAM OF THE SPINE SHOWING A CRUSH FRACTURE OF THE FIRST LUMBAR VERTEBRA.

(iii) *Fracture of the Transverse Processes* is occasionally met with in the lumbar spine, and is frequently not diagnosed the symptoms usually being attributed to myelalgia.

(iv) *Partial Fractures* through the bodies are not very uncommon and take the form either of an incomplete fissure with little or no displacement, or of a compression fracture. The latter results from falls on the head or shoulders with the spine flexed as in falls from horseback or from being blown up as by gas explosions or shell bursts in military operations. One or more vertebrae may crumple up more or less with or without displacement but usually without loss of continuity. There may be some irregularity of the spine with tenderness over the spinous processes but a definite diagnosis can only be reached by very accurate and clear stereoscopic radiography. Pain and

rigidity are experienced with a variable degree of nerve root irritation and the condition may be followed by traumatic spondylitis (p. 825).

In any of these cases symptoms of involvement of the cord may arise either immediately from concussion or at a later date from hæmorrhage and are then sometimes of the gravitation type (p. 766).

Treatment—In all cases of fracture of the body of a vertebra it is very important to avoid flexion of the spine because flexion increases the angular deformity; therefore the case should be transported face downwards on the stretcher. If an X-ray film confirms the diagnosis of a compression or crush fracture of the spine (Fig. 428) the sooner a plaster jacket is applied the better. This jacket must keep the spinal column in the extended position. No anæsthetic is given to the patient, as the extended position can be maintained more easily by the conscious patient. Watson Jones has devised a very practical method of treating these fractures in the extended position. The patient is

given one-third of a grain of morphia half an hour before the plaster jacket is applied. Then two tables are arranged end to end with a

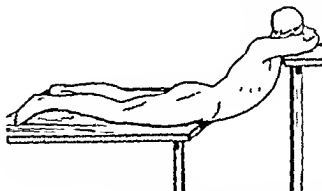


FIG. 429.—METHOD OF PRODUCING HYPEREXTENSION OF THE SPINE

considerable space between them. The front table is then raised on blocks so that it is some two feet higher than the other. The patient is carefully lifted face downwards on to the lower table and a double layer of stockinet is pulled over the trunk and fixed over the shoulders and beneath the perineum by means of a few stitches. The bony prominences, i.e. spinous processes and iliac crests, should be protected by pads of sorbo sponge. By means of two assistants the patient is now assisted into such a position that he is gripping the edge of the higher table with his abducted arms while the lower table supports his lower limbs (fig. 429). This position causes hyperextension of the spine. Plaster of Paris bandages are applied at once and should extend up to the neck, down to the sacrum and over the trochanters of the femur (fig. 430). When the plaster is dry the patient is encouraged to move about in bed. After ten days the patient is allowed up, but the vertebral column must be protected for four months.



FIG. 430.—PLASTER JACKET FOR CRUSH FRAC-
TURES OF THE
SPINE

Non recognition of this type of accident is one of the causes of the persisting backache which so often follows accidents to the spine where no gross lesion can be detected. Slight displacements of the bodies of the lumbar and dorsal vertebrae presumably accompanied by slight unrecognizable fractures, can also be demonstrated radiographically now and then and cause traumatic spondylitis on the one hand or be the physical basis of numberless nerve symptoms often designated as traumatic neurasthenia on the other. Nerve-root phenomena may also be prominent (p. 430).

(B) **Complete Fractures** are usually associated with displacement and loss of continuity of the spinal column and hence are often termed **Fracture-Dislocations**. They result either from direct or indirect violence and are most common in the lower cervical or upper dorsal region. There is always a tolerably extensive lesion (Fig. 431), thus the spinous processes and laminae may or may not be fractured, the ligamenta interspinosa, supraspinosa, and subflava torn, the articular processes fractured in the lumbar and dorsal regions, or displaced without fracture in the cervical, and either the intervertebral substance is torn across or the bodies of one or two adjacent vertebrae are broken thus severing the spine into two halves. The upper

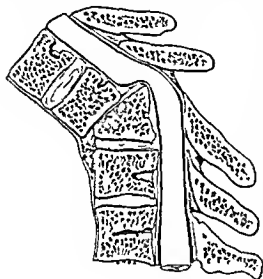


FIG. 431.—COMPLETE FRACTURE-DISLOCATION OF THE SPINE IN THE LOWER DORSAL REGION WITH DISPLACEMENT AND COMPRESSION OF THE CORD

or movable portion is usually driven forwards over the lower or more fixed fragment, and impaction or comminution is often present. The spinal cord is compressed between the upper end of the lower fragment and the laminae of the upper fragment, and although the displacement may be naturally remedied by the falling back of the bones into position ('recoil'), yet the effects of the crush on the cord are usually irremediable. In slighter cases the spinal membranes may be merely punctured by a splinter of bone, or hemorrhage may

occur either within the membranes or outside them in the fatty theca vertebralis. Excessive indirect violence may lead to an associated fracture of the sternum.

The **Signs** of a complete fracture are usually very evident, consisting of local pain, swelling, and bruising, and a certain amount of angular deformity, although the latter often disappears when the patient is laid flat on his back for transport to his home or to the hospital. It may be possible to elicit crepitus if the parts are not impacted, but all unnecessary movement should be avoided for fear of adding to the injury of the cord. Paralysis below the part injured is present in most cases and with it some amount of general shock. When the cord is disintegrated or divided complete flaccid paralysis of the parts below is developed together with anesthesia, and a fatal issue often

occurs at an early date from toxæmia, preceded by septic cystitis or sloughing of the nates. Lesions of the cervico dorsal region in which the cord is extensively damaged quickly become dangerous to life in that they cause paralysis of the muscles of respiration, with the exception of the diaphragm and hence predispose to static pneumonia. Complete lesions at or above the level of the fourth cervical segment are usually fatal at once from involvement of both phrenic nerves. The general mortality of fracture dislocations of the spine is about 70 per cent. The special phenomena of paraplegia at different levels are dealt with at p 800.

The **Prognosis** of these cases turns largely on the situation of the injury and the amount of mischief sustained by the cord. The higher the lesion, the greater the danger, although patients with paraplegia from cervical fracture may live for years and even partially recover, if the cord has not been totally disintegrated.

The **Treatment** naturally varies with the character of the case. The patient is carefully placed on a prepared bed, the greatest gentleness being used in handling and lifting him, for fear of increasing the damage to the cord. The bed must be firm, though not hard, perhaps the best type to employ is a divided horsehair mattress placed over fracture boards, nothing more soft or yielding is permissible. Spring beds and wire-wove mattresses are most undesirable. A water-bed is required in the later stages, but should not be used at first, as it is scarcely firm enough. The shock resulting from the accident is treated in the usual way by warmth and if need be by stimulants, but it must be remembered that anæsthetic regions of the body can be easily blistered or burnt by hot water bottles, unless carefully guarded by flannels. When reaction has occurred, a more thorough examination of the patient can be made, and the subsequent course of treatment decided on.

(a) In a small minority of cases, *operative treatment* is justifiable, and has for its object either the immediate fixation of the fracture (Albee's operation), or the relief of pressure on the cord (laminectomy). For details of these proceedings, see p 804.

(b) When displacement persists owing to impaction of the fragments, *reduction* under an anæsthetic may possibly be undertaken, provided that the lesion is not in the cervical region and the paraplegia not complete. Of course, if other internal injuries are present which render the case hopeless, nothing active should be done. Great care must be used in attempting reduction, since any undue violence may readily increase the mischief, in the lumbar region, however, considerable force may be employed without much danger. Whether reduction is accomplished or not, the further treatment must be directed in accordance with the indications given in the next section. Where the surgeon fails to reduce the deformity, it may sometimes be advisable to make gradual weight extension from the feet or neck.

(c) In many cases, as soon as the patient is laid flat on a bed, the displacement remedies itself, especially if the spine has been comminuted, and then the treatment must be *symptomatic*, as also after reduction or operation where the paraplegia persists or is only slowly

recovered from. He is kept in bed absolutely flat, and with the head low perhaps some form of mechanical support e.g. a plaster of Paris or leather jacket may be desirable but its application is a matter of difficulty unless a special table is available and in the early stages it does but little good. Food is regularly administered and at first must be light and readily assimilable.

The chief care of the attendants must be directed to the skin bladder and bowels. *Bedsore*s are extremely liable to form on all points of pressure and hence the nates and heels must be carefully guarded. In turning the patient to attend to the nates the body must be rolled over as a whole and not merely the pelvis twisted. When the bladder is paralyzed the urine may be withdrawn by a catheter. One of the chief dangers that the patient runs is from the supervention of septic cystitis and the extension of the inflammation upwards to the kidneys. This is generally due to infection from without and the greatest care must be taken to prevent it. The penis should be thoroughly purified, and in the intervals between instrumentation wrapped in a dry sterile dressing. Only soft rubber catheters are employed and these must be boiled before use and lubricated with some sterile material. Should infection occur the bladder is irrigated twice daily with some mild antiseptic such as Condy's fluid boric acid boro-glyceride (1 in 20) or sanitas (1 in 20) whilst urotropine or some other urinary antiseptic is administered. Probably in spite of all precautions the condition will persist and prove fatal from extension to the kidneys. Recognizing this fact it has been recommended by some authorities to allow the condition of distension with overflow to occur in order to avoid the passage of catheters the urine is permitted to flow away into sterile flasks frequently changed. It has however been proved that massage of the prostate as recommended by the late J. B. Murphy, is effective in determining reflex micturition and if suitable male attendants are available this method should always be employed but it is useless if once catheterization has been started. The *bowels* are always obstinately constipated and must be opened either by purgatives or simple enemata.

Under such a regime the patient may gradually recover but more often succumbs to chronic toxæmia or exhaustion. Occasionally he may live for a long time although paralyzed not unfrequently developing some amount of reflex micturition if the lumbar centres are not involved. Varying degrees of restoration of power in the lower limbs are observed if the cord is not completely divided.

Dislocations of the Spine can only occur in the cervical region. The reason for this depends partly on the greater fixity of the dorsal and lumbar vertebrae and partly on the direction of their articular processes. In the cervical region these look mainly upwards and downwards with a slight slope forwards and backwards so that it is not difficult for one to slip over the other in the dorsal and lumbar region they are placed nearly vertically and dislocation is impossible without a serious concurrent fracture although slight displacements may quite well occur (p. 788).

Any part of the cervical region may be the seat of a dislocation

The *occiput* has been displaced from the *atlas* in a few cases, resulting in sudden death, but if incomplete, life has been prolonged for a few hours or days. Dislocation of the *atlas* from the *axis* has followed blows on the neck, or has been the cause of death in hanging whilst the attempt to lift a struggling child by the head has sometimes led to this calamity. In almost all cases the odontoid process has been fractured or the transverse ligament torn causing instant death from compression of the cord, owing to the head and atlas slipping forwards. Lateral displacement from rotation has also been observed, the cord symptoms then being of a milder type.

Dislocation may occur between any two of the *lower five cervical vertebrae*, but perhaps most frequently between the fifth and sixth. It is most commonly unilateral, and almost invariably the result of forcible flexion of the head and neck together with rotation. The head and upper portion of the spine are displaced forwards and twisted, so that the articular process of the upper vertebra involved slips over the front edge of the lower opposing articular process, and becomes caught by it so that it cannot return.

When the lesion is *unilateral*, the head is turned towards the opposite side, and more or less fixed, and the ear is raised. There is no evidence of compression of the cord, although tingling and neuralgic pains are caused by pressure upon and stretching of the nerve-roots of the intervertebral notch. The spinous processes may be irregular and displaced laterally and the line of the transverse processes is similarly altered. Such signs are, however, very difficult to make out in thick necks, and in consequence the condition is sometimes overlooked and left unreduced giving rise to deformity, and permanent neuralgia may result. However, a good skiagram will often clear up the diagnosis. In early cases *replacement* may be accomplished. The patient is *anæsthetized* the body fixed, and traction made upon the head and neck away from the side of the *dislocation*, so as to unlock the edges of the articular processes. Reduction may be effected with a definite snap or catch. In old-standing cases an operation may sometimes be attempted to relieve pressure on the nerves, but it is impossible to replace the bones.



FIG. 432.—DISLOCATION OF THE CERVICAL SPINE (COLLEGE OF SURGEONS MUSEUM)

The fourth cervical vertebra is displaced forwards projecting in front of the fifth the body of which compresses the spinal cord.

If the condition is *bilateral* and complete (Fig. 432), there is a more serious involvement of ligaments, and the anterior displacement of the upper segment is such as to lead to grave pressure upon the cord.

and paraplegia. Occasionally however the lesion is only partial and then the cord may escape without immediate injury owing to the large size of the canal in this region although hemorrhage and inflammation may subsequently cause grave symptoms. *Treatment* is of but little avail in most of the cases of complete double dislocation since probably the cord is irretrievably damaged but when paraplegia is incomplete it is possible that benefit may arise from early interference. Replacement by traction on the head with the neck flexed may be first carefully tried and failing that open reduction should be attempted. After stripping the muscles from the bones the surgeon will see the two cartilage-covered surfaces of the upper articular processes of the lower vertebra standing out clearly behind the laminae of the displaced bone. Upward traction on the head may now again be made and reduction thus secured but if this does not succeed a small portion of the upper margins of the exposed articular processes is excised in order to allow of the unlocking of the bones. If the whole processes are removed reduction is easier but recurrence is certain it is impossible subsequently to fix the parts.

Affections of the Cord associated with Spinal Injuries

Injuries of the spinal column are frequently associated with or followed by conditions affecting the cord and its membranes which may lead to the gravest results even when the local lesion to the spine has been comparatively slight. These are frequently blended with one another in the most puzzling fashion but for simplicity's sake we shall discuss them here separately without attempting to describe the various combinations. In the adult the spinal cord terminates at the lower border of the first lumbar vertebra but in infancy it finishes at a lower level (Fig. 433).

Direct Concussion—This condition may be due to severe blows on the back which do but little damage to the spinal column or may be caused by accidents which lead to the infliction of greater mischief but without any serious displacement of parts. There can be little doubt that the condition is due to the presence of minute extravasations in the cord.

The *Symptoms* produced are those of loss of function of that portion of the cord situated below the point struck. The patient is usually prostrate from general shock and the reflexes are absent. Death may be caused at once by a blow in the cervical region or varying degrees of loss of power and sensation may be produced in any or all of the limbs. In the lumbar and dorsal regions the patient complains of weakness of the legs and loss of control over the sphincters. Priapism never occurs in simple concussion. The temperature of the body is depressed the pulse is rapid and weak and the respirations are shallow. The *Prognosis* is generally good the patient recovering after a time it is unusual for organic disease to follow.

In the *Treatment* absolute rest to the spine is of the greatest importance and this should be maintained if possible in the prone position so as not only to diminish static congestion but also to

remove any pressure on the spine, and to allow topical applications to be made. A spinal icebag may be applied, or the back may be dry cupped, and the patient is kept on a low diet. The bladder and bowels may require attention, but no special drugs are necessary.

Spinal Hæmorrhage can here only be discussed as resulting from injuries. It occurs, however, apart from traumatism, and then most frequently in young persons between the ages of ten and twenty.

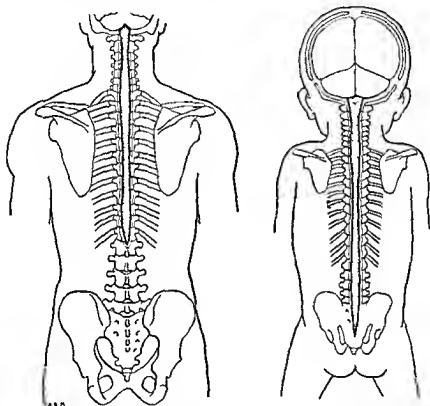


FIG. 433.—DRAWING SHOWING THE EXTENT OF THE SPINAL CORD IN RELATION TO THE SPINAL COLUMN IN AN ADULT AND A SIX MONTHS FÆTUS

The bleeding may take place either into the cord itself or outside it, and hence the two following varieties are described

(a) **Intramedullary Hæmorrhage**, or spinal apoplexy (*hæmatomyelia*), is usually met with in the lower cervical region, and results from some accident that causes acute flexion. Extravasation into the cord is rarely extensive, and may occur in the form of one clot, generally not larger than an almond, or more commonly in many spots, the grey matter being more or less ploughed up. The white matter is compressed, and sometimes the blood bursts through it into the subarachnoid space. Should the patient survive, secondary degenerations

are established and run the usual course. The patient is suddenly struck down with a more or less complete paraplegia and with perhaps pain in the back shooting round to the chest and early followed by a rise of temperature. The paraplegia consists of a flaccid paralysis of the arms due to destruction of these centres and of the legs from interference with the descending columns. Some degree of recovery follows especially in the legs but the parts supplied from the damaged portion of grey matter i.e. the arms are likely to remain paralyzed. In slighter cases only involving the grey matter the arms alone may show signs of paralysis from the first. The *Diagnosis* of hæmorrhage turns on the rapid onset of paralytic symptoms without spinal irritation fever may ensue for a few days and if the cervical region is affected extreme contraction of the pupil (myosis) may result from destruction of theculo spinal centre. There is retention of urine and fæces and priapism is common. The *Prognosis* depends on the size and situation of the clot hæmorrhage in the cervical region may be immediately fatal by interference with the respiration whilst in the lumbar region it is unfavourable on account of the effect upon the sphincter centres. The outlook is best when the dorsal portion of the cord is affected. The *Treatment* is the same as was indicated for direct concussion whilst the administration of a few doses of ergot may be beneficial.

(b) *Extramedullary Hæmorrhage (hæmatorachis)* is a more frequent complication of spinal injuries such as sprains or limited fractures than the former. The blood is extravasated between the bones and the dura mater especially in the cervical region but is occasionally found within the dura. The symptoms are those of spinal irritation, e.g. pain hyperæsthesia spasms cramps etc. followed after a time by loss of power in the muscles supplied from the damaged area or by gravitation paraplegia (Thorburn) which gradually extends from below upwards causing death by asphyxia the whole series of phenomena being afebrile. In intramedullary hæmorrhage the symptoms of paralysis are more violent and those of irritation less marked. If a diagnosis is made ergotin may be injected subcutaneously and ice applied to the spine or even laminectomy performed to relieve pressure later on prolonged rest is required to permit of the absorption of the clot.

Spinal Meningitis may spread downwards from the head or commence as a local affection. Two forms are met with resulting from injury.

(a) *Acute Spinal Meningitis* is usually seen in conjunction with a similar condition of the cerebral meninges for even though it follows an infected wound of the spine it quickly spreads upwards and the cerebral manifestations give the chief colour to the picture. It affects the arachnoid and pia mater (leptomeningitis) which lose their polish and become hyperæmic whilst an abundant effusion containing leucocytes and bacteria and even lymph or pus occurs should the patient live organization of lymph may lead to extensive adhesions. Clinically the disease is ushered in by a rigor and runs a markedly pyrexial course. The special symptoms attributable to the spinal

trouble are pain in the back, deep-seated, boring and severe, increased on all movements, and often extending down the limbs or around the body, rigidity of the spine and limbs, accompanied by painful cramps and muscular spasms, extreme hyperæsthesia, especially of the legs, and increased reflex excitability. Limitation of the disease to the spine may be associated with the appearance of paraplegic symptoms and death from toxæmia, bedsores, or bladder troubles more usually the patient dies from coma, due to the cerebral infection. *Treatment* must be undertaken along lines similar to those employed for the cerebral form of meningitis, viz drainage of the effusion by repeated lumbar puncture, and possibly the introduction of suitable antisera into the meninges after withdrawal and bacteriological examination of the exudate. Symptomatic treatment is required in order to gain sleep and to protect the nates, bladder, and rectum. The spinal icebag may be of some service in relieving pain.

(b) **Chronic Meningitis** is usually localized, and may involve either the arachnoid and pia mater (leptomeningitis), or be mainly limited to the dura mater (pachymeningitis). It may originate as a chronic affection, or is the sequela of an acute attack and is more likely to supervene in syphilitic individuals. The membranes become thickened, and adhesions to the cord may occur, a chronic sclerosing myelitis is frequently associated with this affection. The *Symptoms* are those of localized pain and rigidity in the back increased on all movements, and accompanied by shooting pains and hyperæsthesia, and perhaps muscular pains and cramps. The reflexes are usually exaggerated, and vesical complications may follow. *Treatment* consists in prolonged rest with counter irritation in the form of blisters or the button cauterly applied to the back, mercury and iodides are administered internally.

Spinal Myelitis may follow injuries of the spine, either as a direct consequence of depressed or displaced bone or from hæmorrhage, it may also be caused at a later date by extension of inflammation from the meninges, or result from compression by lymph, pus, granulation or cicatricial tissue, or callus. It may be acute or chronic. In the former the cord becomes red and softened the nerve elements are destroyed, and finally replaced by cicatricial tissue if the patient lives long enough. In chronic cases the connective tissue becomes thickened, and the nerve structures compressed and disintegrated, whilst the meninges are always adherent and thickened.

Symptoms—**Acute myelitis** is evidenced by the presence of pain in the back and along the course of the nerves arising from the inflamed area, soon followed by paraplegic symptoms, if these are not already present as the result of the injury. Slight irritative symptoms sometimes precede the paræsthesia. **Chronic myelitis** gives rise to a great variety of symptoms, but those most marked are a gradually increasing motor weakness, going on to paralysis, together with various sensory phenomena ending in anæsthesia, and there is trouble with the bladder and rectum.

The *Treatment* of each of these conditions is mainly symptomatic.

Spinal, or Traumatic, Neurasthenia (Sj) Railway Spine.—Cases

are not uncommonly met with in which although there has been no direct injury to the spinal column or cord and no immediate symptoms of importance the fact is manifestly demonstrated in various ways that considerable commotion and disturbance have been produced in the nervous system. Railway accidents are the most common cause of this condition but it may arise from any jar to the spinal column or even after injuries to other parts of the body. The essential features are cerebral and not spinal. The reason why railway accidents are so often responsible for this state is that the forces concerned are very great and the collision unexpected so that the muscles and braments are taken at a disadvantage being off their guard whilst the shock, terror and mental disturbance are also important factors. Ligamentous and muscular lesions *i.e.* sprains and strains are the usual local phenomena produced by such accidents.

In the majority of cases the symptoms are mainly due to excessive irritability and weakness of the spinal and cerebral centres constituting a condition of nerve prostration or *Neurasthenia*, and the history will usually be somewhat of this type. The individual at the time of the accident is thrown from side to side or severely shaken but does not lose consciousness and although feeling somewhat dazed is able to alight without help and may even assist others. He perhaps continues his journey and goes to his business but finds in the course of a few hours that his back is painful his head aching and that he cannot apply himself to his work. He returns home and goes to bed sends for his doctor who will probably prescribe rest and bromides. His condition remains for a time unaltered he complains of pain and tenderness over certain regions of the spine especially the lumbar and is unable to walk or to undertake any serious mental or physical effort whilst all excessive sensory stimuli such as a bright light or noise are unusually disturbing. Neuralgia is often present the pulse is weak the urine may be retained or dribble away sexual power is lost and the temperature may be for a time subnormal. Accommodative asthenopia (or the inability to accommodate for near objects) resulting in a temporary condition of presbyopia is also a marked feature in many of these cases. All the symptoms are aggravated by mental excitement and exertion such as are produced by the necessary interviews with doctors and solicitors pending the financial compensation by the railway company. The immediate improvement which often follows the satisfactory settlement of his claim for damages is not necessarily due to imposture but may result from the removal of mental tension and anxiety.

This condition of neurasthenia may develop immediately after the accident as an acute condition the patient lying helpless and prostrate or more often chronically as in the more common type of case described above. To it however is frequently added a considerable element of *Hysteria* in the form either of an acute attack of hysterics or of a chronic unconscious exaggeration of the sensory symptoms. If the patient is examined in the supposed hyperæsthetic area whilst his attention is distracted possibly no pain will be complained of.

The *Prognosis* is generally favourable the patient recovering in

time, but in a few instances permanent effects may be produced, or even a condition of chronic myelitis

In the *Treatment*, a good deal of care is needed to judge rightly when the period has arrived for encouraging movement rather than rest, and thus to prevent the patient from developing a condition of chronic invalidism. Rest in bed is to be recommended at first, bromides given in moderation, and fomentations applied locally. Later on, friction with liniments and massage should be employed, and when all chance of secondary inflammatory disturbance is at an end, movement should be encouraged, and change of air advised, whilst a course of strychnine and iron may be administered.

Paraplegia has been mentioned so frequently in discussing the injuries of the spinal column and cord that a more detailed reference to it is essential.

Causes.—(1) It may arise as the direct result of the injury and then is due to displacement of bone or hæmorrhage. (2) It comes on at a slightly later date as a consequence of extramedullary hæmorrhage (localized or of the gravitation type) and that usually without pyrexial phenomena. (3) It may be due to the pressure of inflammatory exudate e.g. lymph or pus, and then is late in its development, and preceded by the pyrexia and irritative phenomena of that condition. (4) It may develop late in the case from the pressure of callus or cicatricial adhesions around the cord or its membranes (*peri pachymeningitis*).

The **Phenomena**, whether due to injury or inflammation, are those of a total transverse lesion of the cord, absolutely destroying one segment. The following symptoms result.

1 Flaccid paralysis of the muscular area supplied by the destroyed segment, followed by rapid atrophy, reaction of degeneration and loss of reflexes in this particular group of muscles.

2 Flaccid paralysis of all the muscles supplied by the segments below that which has been destroyed. The trophic condition remains normal, at any rate for a time, but later, when secondary descending degeneration in the antero lateral columns has occurred, the muscles become contracted, tense, and rigid (late rigidity).

3 Complete *anæsthesia* of the sensitive area supplied by the destroyed segment, and of all the sensitive areas below, and loss of the muscular and thermal senses.

4 A narrow zone of *hyperæsthesia* is found at the upper level of the *anæsthetic* area, due to the irritation of the nerve roots at the site of injury (girdle-pain).

5 Total loss of all the reflexes, deep and superficial, occurs, with the exception of the tonic contraction of the sphincters of the bladder and rectum. In the course of two or three weeks an extensor response appears to gentle plantar stimulation, and possibly this may in time elicit a 'mass reaction' of the muscles of the leg and even of the abdominal wall. The superficial reflexes may reappear, and occasionally the deep ones, but in the presence of septic complications they often disappear, and the limb relapses into a flaccid state, the extensor reflexes vanishing first.

6 Vasomotor paralysis combined with trophic disturbances in the parts which are paralyzed

7 Visceral changes especially in the bladder and rectum. In the bladder two stages occur (a) The period of complete *retention* due to the interference with the voluntary control permitting the tonic action of the sphincters to be maintained as a result probably of the micturition centre being situated in the

sympathetic hypogastric mesenteric plexuses. The bladder becomes distended and unless relieved by catheterism incontinence with a full bladder follows. (b) After a while the bladder wall begins to regain its tone and small acts of expulsion of urine occur although the catheter may still be required. In time periodic reflex micturition develops in which a varying quantity of urine collects in the bladder, and is unconsciously and involuntarily expelled. This is the typical *automatic bladder* of a paraplegic patient and occurs even in some cases where the lesion is limited to the cauda equina.

Cystitis is only too liable to follow and is of a grave nature, possibly associated with sloughing of the vesical mucosa and hæmorrhage and terminating in an ascending pyelonephritis and uremia. The cause is almost always septic catheterism occurring in an individual of low vitality and in tissues of diminished resistance.

The rectum is also affected in the direction of incontinence of feces and marked constipation. This condition has to be carefully watched as it will certainly predispose to bed-sores.

Phenomena of Paraplegia at Different Levels—I At the Upper End of the Sacrum—Total transverse lesions at this spot are not uncommon they involve the cauda equina and cause paralysis of the sacral plexus. The effects produced are (1) Paralysis of all the muscles of the legs except those supplied by the anterior crural the obturator and the superior gluteal nerves whilst the perineal and penile muscles are also affected. (2) Anæsthesia of the penis scrotum

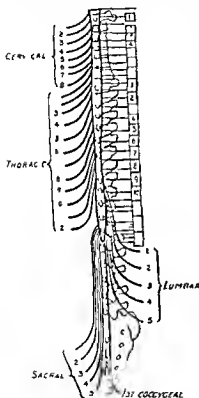


FIG. 434.—DIAGRAM SHOWING THE RELATION OF THE SPINAL NERVES AND SEGMENTS OF THE SPINAL CORD TO THE VERTEBRAL SPINOUS PROCESSES.

perineum, lower half of the gluteal region, and the whole of the legs, except the front and outer parts of the thigh, which are supplied by the cutaneous branches of the anterior crural, and the region supplied by the long saphenous nerve (iii) The bladder and rectum are influenced as described above (Fig 434)

2 If the lesion is situated in the *Dorsi-lumbar* region, or passes through the lumbar enlargement, which corresponds to the twelfth dorsal and first lumbar vertebræ, there is complete paralysis of the muscles of both limbs, including those passing to them from the trunk. total anæsthesia of the legs, gluteal and perineal regions, and possibly the lower part of the abdomen

3 In the *Mid-dorsal* region the same phenomena are met with but to them are added a more extensive region of anæsthesia, limited above by a hyperæsthetic zone which feels like a tight painful girdle round the waist Paralysis of the flat abdominal muscles also occurs and is a most important addition to the gravity of the case, for all straining movements are thereby prevented, and thus coughing is embarrassed and defæcation hindered The gases developing from the stagnant faces accumulate and cause distension of the belly (meteorism), and thereby respiration may be seriously impaired The diaphragm, moreover, is hampered in its action, since the lower ribs cannot be fixed or steadied and hence its contractions tend to pull them inwards, instead of increasing the dimensions of the thoracic cavity

4 In the *Cervico-dorsal* region all these phenomena are present, but the anæsthesia extends over nearly the whole trunk, and the hyperæsthesia may involve the arms, whilst the intercostal and spinal muscles are also paralyzed and there is some weakness of the hand grasp Respiration has to be carried on by the hampered diaphragm, with the assistance of a few of the accessory respiratory muscles in the neck, and hence is much impeded, if bronchitis is present, it will prove fatal by asphyxia in a few days from the inability to cough Priapism is a marked feature of cervical paraplegia, as also contraction of the pupil from interference with the lower cilio spinal centre

5 In the *Lower Cervical* region the arms also become involved in both the paralysis and anæsthesia, and the patient is likely to die in thirty six to forty-eight hours, or less, in a condition of hyperpyrexia If the lesion is situated at or above the fourth cervical vertebra, instant death results from paralysis of the phrenics and intercostal nerves and consequent stoppage of the respiration If the fifth cervical segment is involved the arms are usually found completely paralyzed, lying by the side of the trunk A lesion through the sixth segment causes the arms to be rolled out and abducted, the elbows being flexed and the hands supinated with the fingers semiflexed (Fig 435) Injury to the seventh segment results in the hands being half closed, the elbows bent, and the forearms lie in a condition of pronation over the chest

Death from Paraplegia, therefore, may arise from a variety of causes and at various periods It may be immediate, from respiratory failure in lesions above the fourth cervical vertebra, or it may occur

from accumulation of mucus or pus in the air passages when the lesion is in the upper dorsal region or it may be delayed for weeks or even months and then be due to softening of the nates or septic absorption from an inflamed or ulcerated bladder, which is often associated with suppurative pyelonephritis.

The Prognosis and Treatment both depend on the position and character of the lesion causing the paraplegia, and on the previous habits and condition of health of the individual.

Incomplete Division of the spinal cord is by no means uncommon, and opportunity of studying it has occurred frequently of late. In the majority of cases the early phenomena cannot be distinguished from those of a complete lesion being due presumably to concussion, and consisting of (a) Complete flaccid paralysis to the level of the lesion (b) anesthesia to a similar level, (c) loss of all reflexes, deep



FIG. 435.—DISLOCATION OF THE FIFTH CERVICAL VERTEBRA ON THE SIXTH SHOWING THE ATTITUDE THE ARMS ADAPT

and superficial and (d) retention of urine. Evidence of the partial character of the lesion may be forthcoming in a few days or weeks by the reappearance of some degree of motion or sensation or by spasticity of muscles. Difficulty arises when the only early change is one of the reflexes: the initial loss is replaced by a reappearance of the deep reflexes (patellar jerk and ankle clonus) of an extensor plantar response and a maintained loss of superficial reflexes. Sphincter symptoms are not to be trusted as giving any indication of the completeness or not of the cord lesion for automatic micturition may develop even in hopeless lesions of the cauda equina.

Hemisection of the Cord—A lesion involving one lateral half of the spinal cord below the cervical region is not very unusual in military work. The resulting symptoms are usually known as the Brown Séquard syndrome and consist in (a) On the side of the lesion motor paralysis of the leg with an extensor plantar reflex and active tendon

reflexes, together with sensory symptoms referable to the division of the posterior column, *viz* loss of the sense of position and of vibration sense, etc., (b) on the side opposite to the lesion there is no motor paralysis, but there is loss of cutaneous sensation to temperature and pain.

Albee's Operation, originally introduced with the object of fixation of the damaged vertebræ in tuberculous disease of the spine (p 823), has of late had its scope enlarged to provide fixation in other conditions, *viz* (1) in fractures of the spine with persistent non-union, (2) in progressive scoliosis, where the condition is increasing and resists treatment, or where it has attained such a degree as to cause constant pain and gross deformity, and (3) with suitable modifications for

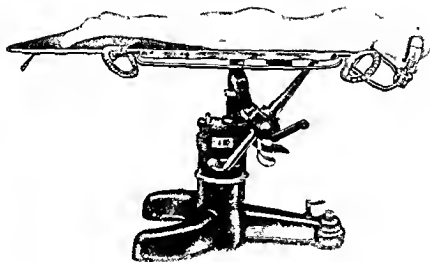


FIG 436—POSITION OF PATIENT DURING THE OPERATION OF CERVICAL LAMINECTOMY

spondylolisthesis (p 497), where rest is insufficient to combat the symptoms.

In fractures it is not often required, but when partial fractures exist which do not unite, and are a cause of continuous pain and discomfort to the patient, it is a justifiable and useful proceeding. The patient is anesthetized in the prone position, and an incision made over the affected area, the spinous processes being cleared of muscles, etc., on either side. The spines are then split longitudinally by a sharp osteotome. A suitably shaped tibial bone graft is cut by means of a twin saw driven by an electric motor, and wedged in between the divided segments of the split spinous processes, it is fixed in place by suturing the muscles and fasciæ of the back over it. The patient is, of course, immobilized in a plaster bed for a time, and the graft

usually unites well thereby determining the fixation required. It is not a serious operation in careful hands and good results may be anticipated.

Laminectomy is an operation for the removal of the lamina and spinous processes of one or more vertebra in order to relieve pressure

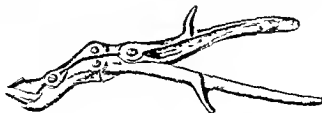


FIG 43 —A USEFUL TYPE OF LAMINECTOMY FORCEPS WITH DOUBLE ACTION

on the cord whether due to depressed bone, abscess, granulation tissue, excessive callus, cicatrices or tumours. The operation consists in making a longitudinal incision in the middle line of the back. The patient lies prone on the operating table (Fig 436). The spinous

processes are then removed by laminectomy forceps (Fig 437). The laminae are next removed. It is a convenient plan to make an opening in the lamina with a small trephine and then enlarge the opening with a double action laminectomy forceps. In order to get a good exposure of the spinal membrane and to remove any irregularities of the cut laminae Hudson's forceps are used (Fig 438). A smooth cut bony surface is thus obtained and if bleeding from the bone is evident it can be readily checked with bone wax.

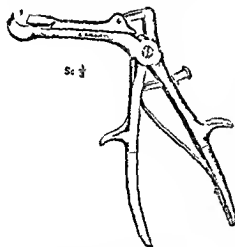


FIG 438 HUDSON'S LAMINECTOMY FORCEPS

The posterior surface of the dura mater is thus exposed and if necessary it can be incised in the mid line and a small grooved director inserted into the opening (Fig 439) and the membrane opened for a considerable distance. Any laceration of the dura mater due to injury is inspected and the various conditions which may be present are dealt with according to

circumstances In this place we have merely to consider the use of this operation after injury to the spine For its employment in other conditions see Chapter XXVII p 829

It must be remembered as a fundamental principle that repair is impossible after the spinal cord has been divided or any one segment totally disintegrated and hence if it is certain that a total transverse lesion of the cord has been caused by an accident it is absolutely useless to operate except to relieve pain due to root pressure This question as to the special features of complete and incomplete lesions has already been alluded to but one would again emphasize the fact that it cannot be absolutely settled in the early stages of the case as it is at first impossible to say whether the symptoms are due to concussion hæmorrhage or bony pressure Fortunately delay does not appear to be so prejudicial to the patient's welfare as one might at first expect and many cases are on record in which a good result was obtained even after months One is therefore justified in waiting a while in doubtful cases In spite of this however there will always be a certain number of patients in whom it is a matter of doubt as to whether or not any benefit will accrue from operation The final decision under such circumstances depends on the general state of the patient

Apart from these doubtful cases the following are generally admitted as being suitable for operation (1) Penetrating wounds or fractures with displacement which involve the spine below the first lumbar vertebra the *cauda equina* is present below that level and not the spinal cord and it is reasonable to treat it in the same way as one would treat a single peripheral nerve (2) when the injury is mainly limited to the neural arch which has been driven in by direct violence (3) in all cases of bifurcal dislocation of the cervical spine where the patient is not moribund (4) if paraplegia arises with or without inflammatory symptoms when an interval has elapsed since the accident the pressure in such cases may be produced by blood or inflammatory exudations and benefit may possibly arise from the operation if however it is due to a total transverse myelitis no good can follow (5) When symptoms of irritation or paralysis supervene at a later date from contraction of cicatrices around the cord or its membranes (peripachymeningitis) or from excessive callus formation laminectomy may be performed with good hopes of a successful result

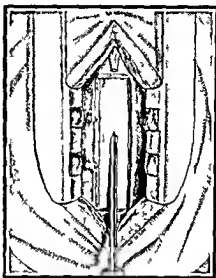


FIG 439—LAMINECTOMY METHOD OF OPENING THE DURA MATER

CHAPTER XXVII

DISEASES OF THE SPINE

Spina Bifida

By *Spina Bifida* is meant a condition of imperfect development of some portion of the posterior aspect of the spine with or without a similar affection of the spinal cord and membranes.

It must be remembered that the spinal cord is developed as a linear involution of the epiblast the edges of this medullary groove growing up and uniting so as to include a passage lined with epithelium and subsequently known as the central canal. The cord is gradually separated from the overlying skin by an intrusion of mesoblastic elements from which the vertebrae together with the spinal muscles and ligaments are developed. The ossification of each vertebra originates in three main centres—one for the body and one for each half of the neural arch whilst epiphyses are developed as plates above and below the body as also for the transverse and spinous processes.

The following are the chief forms of *spina bifida*.

1 A *Myelocoele* results from non-closure of the primitive medullary groove. It is characterized by the appearance on the lumbo-sacral region of a raw surface which consists of the spread-out structures of the cord at the upper part of which opens the central canal. The condition is incompatible with life and the child if not stillborn as is usually the case does not live beyond a day or two.

2 A *Meningocele* (Fig. 440) is characterized by a protrusion of the membranes containing cerebro-spinal fluid through a defect in the posterior walls of the vertebrae the spinal cord and nerves being in their normal position. This variety is not very common.

3 A *Meningo-Myelocoele* (Fig. 441) is due to a development of fluid within the membranes which remain adherent to the skin the spinal cord or nerves of the cauda equina passing down the posterior aspect of the cavity as a strap and the nerves traversing and perforating the sac to reach the intervertebral foramina.

4 A *Syringo-Myelocoele* (Fig. 442) arises from a distension of the central canal of the cord the posterior portion of which usually remains adherent to the skin from which it has never been separated owing to defective development of the mesoblastic tissues. The spinal nerves travel round the walls of the cyst in order to find their way to the intervertebral foramina. Trophic phenomena are nearly always a prominent feature of these cases.

Of these forms the *meningo-myelocoele* is that most frequently seen in living children although according to Bland Sutton the first is really the most common.

Clinical Characters—A spina bifida (except of the myelocoele type) is recognized by the presence of an elastic swelling in the middle line of the back (Fig 443) most commonly involving the lower part of

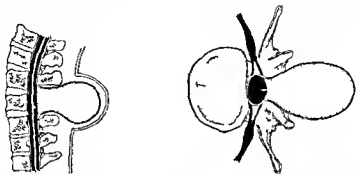


FIG 440—HORIZONTAL AND VERTICAL SECTIONS OF A SPINAL MENINGOCELE

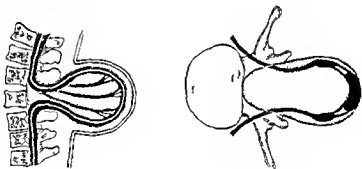


FIG 441—DIAGRAM OF A MENINGO MYELOCELE

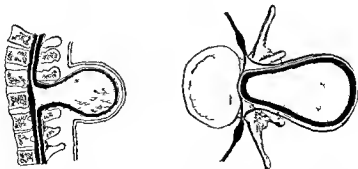


FIG 442—DIAGRAM OF SYRINGO MYELOCELE

the spine it may be covered by normal skin from which may arise an abnormal growth of hair but usually that over the convexity is thin and translucent and not unfrequently a number of small dilated

vessels are seen coursing over it. On compressing this swelling, its size can sometimes be diminished and then in infants distension of the anterior fontanelle may be felt showing that the sac is filled with cerebro-spinal fluid there is usually a distinct impulse on coughing or crying. The margins of the defects in the vertebrae can often be felt at the base of the swelling. Other deformities may be associated with spina bifida especially hydrocephalus and paralytic talipes whilst perforating ulcer, ankylosis of phalanges and other trophic phenomena are frequently developed at a later date.

The Diagnosis is usually evident but sometimes in the cervical region a small tense meningocele is not readily recognized. Radio-graphy may be of assistance in demonstrating the defects in the vertebrae.

The Prognosis of the case depends mainly on the thickness and character of the overlying skin. If it is thin and atrophic as in many cases of meningo myelocle the sac is likely to give way causing death from sudden escape of cerebro-spinal fluid or from infective meningitis. If the spina bifida is small and covered with healthy skin and subcutaneous tissue the patient may reach adult life but even then trophic phenomena may supervene possibly as the result of the presence of foci of navoid tissue which have been known to develop in the canal when the cord is absent. Occasionally a meningocele with only a small aperture of communication with the spinal canal is cured spontaneously by gradual growth of the bones.



FIG. 443.—LUMBO SACRAL SPINA BIFIDA SHOWING DEFORMITIES OF THE FEET

Treatment—Some cases are best left alone the tumour being merely guarded from injury by the application of a suitable cap but if the sac is thin and gradually increasing in size surgical intervention is absolutely necessary. Acupuncture or tapping through the healthier integument around the base repeated perhaps several times and followed by compression may lead to a cure in favourable cases.

Operative treatment is chiefly applicable in the meningocele type and infants or those suffering from trophic phenomena do not stand it well. An incision is made over the sac either in the middle line if the cord is not there or to one side if it is. The child should be kept with the head low so as to limit as far as possible the loss of cerebro-spinal fluid. In a meningocele the membranes are cut away, after tying or suturing carefully the pedicle and the spinal muscles drawn together so as to create an extra protective barrier in addition

to the skin and subcutaneous tissues. When the cord runs down the back of the sac, it is freed by incisions on either side, and if it cannot be separated from the skin, the whole strip is replaced in the vertebral canal, the membranes are closed over it, and finally the muscles and skin. The results in the treatment of meningoceles have been most encouraging.

Spina Bifida Occulta is the term applied to a condition in which the posterior portion of the vertebræ is absent, but without any protrusion of the cord or its membranes. The overlying skin may be cicatricial in character, or a large growth of hair may arise from it (Fig 444), occasionally a lipoma develops in this situation, and by its growth compresses the spinal cord or drags upon it, and causes paraplegia. Unless such a condition is present spina bifida occulta calls for no treatment but an exploratory operation should always be undertaken when nervous phenomena supervene.

Congenital Sacral or Coccygeal Tumours.

The majority of these arise from what is known to embryologists as the *neurenteric canal*. In early foetal life the neural and alimentary canals are continuous the passage of communication being known by the above name. Ordinarily it disappears entirely after the union of the proctodeum with the intestine but evidences of its existence are occasionally met with, either in the form of a cicatricial dimple adherent to the tip of the coccyx (*post anal dimple*), or as one of the following conditions.

(1) A *dermoid cyst*, containing the usual mixture of sebaceous material and epithelial cells, and often a tuft of hair, it develops in the space between the rectum and coccyx, and may either project below or by the side of the coccyx, or open into the rectum, the tuft of hair may then find its way out of the anus. The cavity may actually communicate with the spinal meninges.

(2) A *congenital adenoma* of the post anal gut (Fig 445) is occasionally found in the same region. It is characterized microscopically by the existence of alveoli, lined by cuboidal epithelium, held together by connective tissue, it may attain a large size, but is quite innocent.



FIG 444.—SPINA BIFIDA OCCULTA IN A GIRL AGED TEN YEARS

Various other tumours are met with in infants in this region and the same title of congenital sacral or coccygeal tumour has sometimes been applied to them.

(a) A *spina bifida* of the meningocele type which may communicate with the subdural space or may have been shut off by a natural process of cure.

(b) A *lipoma* may also form here and in some cases has simulated by its shape a caudal appendage.

(c) A partially-developed fetus may be met with enclosed within the subcutaneous tissues of the sacral region and known as a *teratoma* (p. 235).

(d) A growth of a mildly malignant character known as a *chordoma* may also be found in this region developing from notochordal tissue.

A similar development is sometimes seen at the other end of the notochord viz. in relation to the basi-sphenoid. It is encapsuled and lobulated and may not only cause absorption of neighbouring bone but also interfere with the pelvic viscera. The histological characters are somewhat indefinite and often of a mixed type.



FIG. 445 — CONGENITAL SACRO-COCYGEAL TUMOUR OF ADENOMATOUS TYPE.

Inflammatory Affections of the Spine

I **Acute Osteomyelitis of the Spine** is uncommon. It usually affects the mobile portions of the spine in young people and may involve the bodies of the laminae. It is characterized by severe pain in a localized portion of the back and fever. Deformity is not marked since necrosis occurs and not a gradually destructive caries. Abscesses form early and when the arches are involved there is great danger of an extension of the inflammation to the spinal meninges leading to a

fatal issue. The prognosis is bad owing to this latter complication and the only possible treatment consists in early incisions to give exit to the pus. Sequestra can be removed from the back of the vertebrae but from the front only in the lumbar and cervical regions. A sub-acute form is occasionally met with usually a metastatic infection with a primary staphylococcal focus. Treatment with a spinal jacket gives relief from the acute pain and the prognosis is favourable.

II **Tuberculous Disease of the Spine or Spinal Caries** (Syn. Pott's Disease Angular Curvature).—The above names are applied to a tuberculous disease of the vertebrae originating almost invariably in their bodies which are more or less destroyed leading to the so-called angular curvature. It was first accurately described by Percival Pott in 1779.

The Causes are much the same as those of tuberculous affections elsewhere and indeed it is often associated with other manifestations of the same disease. It most frequently occurs in children under the age of ten years (75 per cent of all cases) and of these it has been demonstrated that 60 per cent are due to infection with the bovine type of tuberculous organism. It may however arise at any age and equally in either sex. Any part of the spinal column may be involved but the lower dorsal is by far the commonest. The cervical region is rarely attacked except in children and young adults whilst in adults the dorsolumbar vertebræ are the favourite seat.

Pathological History

—The disease commences either as a periostitis or an osteomyelitis. The *periosteal* variety rarely occurs except in adults. It involves the anterior surface of one or more vertebræ and spreads under the anterior common ligament from one bone to another whilst the *intervertebral discs* are also attacked and destroyed. The *endosteal* form is much the more common and is almost invariably the type seen in children.

The tubercle is deposited in relation with the plate like epiphyses of the bodies and produces its usual effect in softening and disintegrating the osseous tissue. The anterior parts of the bodies are affected more than the posterior and hence deformity is common and nervous affections rare. The deformity is more or less of an angular type due to the bodies falling together either from the weight of the trunk or from muscular action or when the patient has been in the recumbent position from the cicatricial contraction which is associated with the healing of the granulation masses in the front of the bodies. The disease spreads to adjacent vertebræ either through the intervertebral discs which are destroyed in the process.

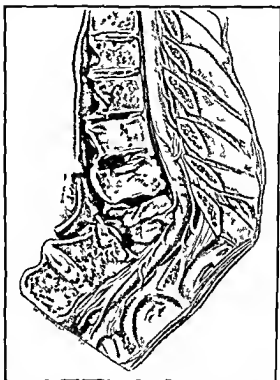


FIG 446.—TUBERCULOUS DISEASE OF SPINE SHOWING DESTRUCTION OF THE BODIES OF THE VERTEBRÆ AND ABSCESS FORMATION BENEATH THE ANTERIOR COMMON LIGAMENT (SPECIMEN IN COLLEGE OF SURGEONS MUSEUM)

or by extension under the anterior common ligament when it may become widely diffused body after body being eroded and the cartilages suffering even more than the bones (Fig 446). In such a case the deformity is not angular but rather of a general kyphotic nature. Occasionally the disease starts simultaneously in many foci so that the bodies of several vertebrae become pitted and carious without producing general destruction. In other cases the process is limited to the bodies and intervertebral discs of two adjacent vertebrae the periosteum being but little affected. This variety is perhaps most common in the lumbar region where the bodies of the vertebrae are large and permit a limiting zone of sclerosed tissue to form, it is also not uncommon in this situation to find definite sequestra in adults (Fig 447). Unequal crumbling and falling in of the sides of the vertebrae will lead to lateral deformity, but this is not very common.

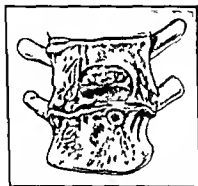


FIG 44.—TUBERCULOUS DISEASE OF TWO LUMBAR VERTEBRÆ SHOWING SEQUESTRUM ON THE ANTERIOR ASPECT AND LATERAL THICKENING PREVENTING ANGULAR DEFORMITY (COLLEGE OF SURGEONS MUSEUM)

Natural cure is effected by the bodies of the vertebrae falling together and becoming ankylosed so that apart from treatment a deformed and immobile condition of the spine is the best result that can be anticipated. The new bone thus formed becomes in time sclerosed and very dense and the synostosis also involves the spines and laminae. In favourable cases this occurs without suppuration but not unfrequently abscesses form. Occasionally the tuberculous process extends backwards through the body of the bone so as to implicate the posterior common ligament and symptoms from pressure on the cord may then arise.

In the upper cervical region the disease usually starts in the large joints either between the occiput and atlas or between the atlas and axis. For a time it may be limited to one side but the body of the bone is attacked at an early stage and the trouble then spreads to other joints. A special complication of this variety will be mentioned hereafter (p 616).

The Signs and Symptoms produced by tuberculous caries of the vertebrae vary considerably in different situations but for practical purposes may be described under the following five headings.

1. **Pain** is a constant and invariable accompaniment of the disease although in the early stages it may not be specially prominent being only elicited by careful examination. It is of two main types the local and the referred. **Local pain** is often not severe but can usually be elicited by pressure or percussion over the spines or perhaps more effectually by pressing upon the transverse processes so as to induce

rotation of the vertebral bodies one on another. Movements of the spine, bending or twisting are similarly painful whilst the same result can be brought about by jarring the spine as by a blow on the head or nates. *Referred pain* is produced by pressure upon or irritation of, the roots of the nerve as they emerge from the intervertebral foramina, consequently its distribution is governed by the arrangement of the nerve root area of the affected spinal segment (p 428). If the lumbar region is affected the pain is referred down the legs in the dorsi lumbar region it may follow the last dorsal nerve and be noticed in the lower part of the abdomen or in the gluteal region in the lower dorsal region pain is referred to the epigastrium children who are unable to differentiate its precise nature complaining of belly ache, in the cervico dorsal region the pain often extends into the arms.

2 **Rigidity** of the spine is a constant accompaniment of Pott's disease. In the *early* stages it results from muscular spasm the object being to fix and immobilize the painful part. If the lower portion of the spine is involved the back is held stiff and straight, the patient abstaining from all movements which would bend or stretch it. Thus in order to pick up an object from the floor the knees and hips are flexed, and the patient gradually lets himself down with an absolutely rigid back into a sitting or squatting posture the body is raised in a similar manner by resting the hands upon the thighs, the patient, as it were, climbing with extended arms up his own legs. In a small child rigidity in the dorsi lumbar region can be demonstrated by laying him on his face with legs together, grasping the two ankles with one hand, and ascertaining the amount of movement in that region by lifting the legs from the table, and also by moving them from side to side, the other hand steadies the body above the suspected lesion. In a healthy child the legs can be elevated and the spine bent back in the dorsi lumbar region nearly to an angle of 60 degrees, whilst lateral mobility to the extent of 30 or 40 degrees on either side of the median line is obtainable. When caries is present, neither of these movements can be made without including the thorax and dorsal spine. In cervical caries the patient steadies the head and at the same time raises the shoulders by the help of the trapezius and sternomastoid muscles whilst the chin is often supported by one hand, and the patient twists his whole body in order to look sideways.

In the *later* stages when repair is taking place or has occurred, rigidity of the spine is due to osseous ankylosis. After a cure has been established, compensatory movements of other portions of the spine mask to a certain degree the localized rigidity.

3 **Deformity** is necessarily present in almost all instances owing to the character of the reparative process. The amount of the deformity depends on many circumstances, and perhaps chiefly upon the number of vertebrae affected. Where only two bones are involved a true angular deformity may result, the body of the upper vertebra being welded to that of the lower, so as to produce a wedge like mass, compensatory curves of the spine above and below enable the patient to assume the erect posture. When a large number of vertebrae are affected the curvature is never angular, but the whole region becomes

bent forwards and that sometimes very acutely (Fig 448) In the lumbar region (and to a less extent in the cervical) loss of the normal forward convexity is often the most marked feature the vertebrae being piled as it were one above the other so as to constitute an absolutely vertical column (Fig 449) When the affection is limited to two lumbar vertebrae there is usually little or no displacement as the disease occupies the centres of the bones so that the sides may escape altogether In the dorsal region the deformity is usually well marked as several vertebrae are often involved the length and obliquity of the spinous processes make the posterior projection very considerable In the cervical region there is rarely much deformity owing

to the small size of the vertebral bodies but if several bones are involved the head may be carried forwards and flexed necessitating considerable compensatory changes in the dorsal or even lumbar regions

Secondary changes in the shape of the thorax accompany advanced cases in the dorsal region the sternum becoming convex anteriorly so as to compensate for the diminished vertical measurement of the thorax and the ribs crowded together The lower floating ribs may however retain their normal position and thus a horizontal groove may be produced corresponding to the line of the tenth rib In such cases the patient becomes much stunted in growth and dwarfed constituting the typical 'hunch back'

4 Abscess is the most serious result of spinal disease for owing to its deep origin it often attains considerable dimensions before it is recognized or treated whilst it is usually impossible to deal with the causative lesion in the bones It is relatively more common in adults than in children The pus collects primarily on the anterior aspect of the vertebrae beneath the anterior common ligament (Fig 446) which may be stripped from the bones for a considerable

distance It thence finds its way to the sides of the bodies after perforating the ligament and burrows in various directions according to the portion of the spine involved

In the cervical region a *chronic retropharyngeal abscess* is first formed it pushes the posterior pharyngeal wall forwards and may be detected from the mouth as an elastic fluctuating swelling which by its size often leads to some difficulty in swallowing and breathing whilst oedema of the glottis may be induced Left to itself it may burst into the pharynx and suffocate the child or at best pyococcal infection follows and the osseous lesion is thereby aggravated Not unfrequently the pus finds its way to the side of the neck behind the vessels



FIG 448—ADVANCED TUBERCULOUS DISEASE OF SPINE IN DORSAL REGION

and sterno mastoid being guided to the posterior triangle by the prevertebral fascia, behind which it is situated. Less frequently it pierces this fascia and presents in the anterior triangle or travels down towards the mediastinum or along the brachial nerves to the axilla.

In the dorsal region the abscess starts in the same way in front of the vertebræ, and usually extends backwards between the vertebral ends of the ribs to form a *dorsal abscess*, which points 3 or 4 inches from the spinous processes and has an impulse on coughing. Sometimes it comes to the surface at the spot where the lateral cutaneous branches are given off, and then they cause tuberculous disease of the ribs, leading to caries or necrosis or even a localized empyema. In

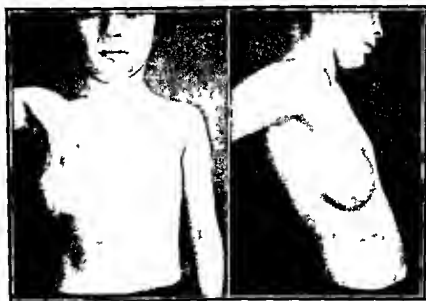


FIG. 449.—LARGE TUBERCULOUS ABSCESS ASSOCIATED WITH DISEASE OF THE FIFTH AND SIXTH DORSAL VERTEBRAL BODIES

disease of the lower vertebræ the abscess generally burrows downwards, passing under the ligamentum arcuatum internum of the diaphragm, and giving rise to a *psoas abscess*.

In disease of the dorsi lumbar or lumbar regions either a lumbar or a psoas abscess may result. A *lumbar abscess* is due to the passage backwards of the pus along the posterior branches of the lumbar vessels and nerves to the outer border of the erector spinæ and usually presents superficially in Petit's triangle, i.e. between the adjacent borders of the latissimus dorsi and external oblique muscles. It there forms a tense fluctuating swelling with an impulse on coughing. A *psoas abscess* (Fig. 450) lies within the sheath of the psoas muscle the pus being usually superficial to the muscular fibres, some of which

are probably destroyed. It is often preceded by a condition of spasmodic contraction of the muscle with limited extension of the thigh which may disappear after a period of rest. In time a resistant mass of a fusiform shape is felt placed deeply in the abdomen as it enlarges it usually burrows outwards under the fascia ilio-crural to form a tense rounded swelling in the iliac fossa (Fig. 451). It thence travels under Poupart's ligament behind and external to the common femoral vessels being constricted at this spot so as to form a narrow neck. The sac then expands behind the common femoral sheath the vessels being often displaced forwards and the vein flattened out and compressed. Thence passing along the tendon of the iliopsoas to the

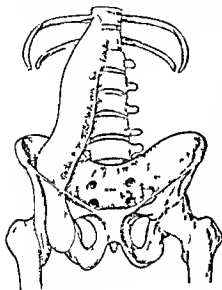


FIG. 450. DRAWING TO SHOW A PSOAS ABSCESS IN RELATION TO SPINE AND PELVIS

neighbourhood of the lesser trochanter the abscess usually burrows amongst the adductor muscles forming a large swelling on the inner side of the thigh and comes to the surface at or near the saphenous opening to the inner side of the main vessels and hence may be mistaken for a femoral hernia. Occasionally the pus follows backwards along the internal circumflex artery, and may point behind the great trochanter in neglected cases the abscess has been known to extend down the leg and has even been evacuated by the side of the tendo Achillis. In a few instances the pus finds its way into the pelvis and then points in the ischio-rectal fossa or possibly burrows through the sacro-sciatic foramen.

In the most typical variety with a pouch both above and below Poupart's ligament communicating by a narrow neck cross-fluctuation can be detected in the lower pouch by compressing the upper or *vice versa*. There is of course an impulse on coughing in the portion below Poupart's ligament.

The constitutional disturbance associated with the formation of these abscesses is usually but slight and there is no leucocytosis perhaps there is a small rise of temperature at night but if as occasionally happens auto-infection with pyogenic organisms occurs this becomes more marked. As the pus comes to the surface considerable pain may be experienced from the tension and irritation of the soft parts.

5 **Nervous Symptoms** occur in about one out of every thirteen patients and then generally in bad or neglected cases. They are

tivity is usually associated with active deep reflexes extensor plantar response and absence of other superficial reflexes.

Tuberculous disease of the upper two vertebrae usually originates in one or more of the large articulations on either side of the atlas if these joints become disorganized displacement may occur at any moment and in this way the occiput slips forwards upon the atlas and may lead to gradual or sudden compression of the cord and consequent death. The disease sometimes spreads to the body of the axis and by this means the odontoid process becomes detached or the transverse ligament gives way in either case the weight of the head carries the arch of the atlas forwards and death ensues at once from compression of the medulla.

Course of the Case and Prognosis—Left to itself the disease usually progresses more or less steadily the bone lesion becoming gradually more marked and abscesses are likely to develop. If treated efficiently and taken in hand early repair by ankylosis may be confidently expected. Even when an abscess forms prolonged rest may lead to its disappearance the fluid part of the pus being absorbed and the solid elements becoming inspissated and dry, forming a putty like mass lying on the front of the vertebral column this may subsequently undergo liquefaction probably owing to infection with pyogenic cocci constituting what is known as a *residual abscess*. Should however the abscess burst or be opened and become septic symptoms of chronic toxæmia supervene and the patient is sooner or later exhausted by the discharge and dies from asthenia. If dealt with judiciously and sepsis avoided the abscess may be cured and if at the same time the spine is kept at rest and suitable hygienic measures are adopted the lesion in the bones is able to consolidate. The onset of paraplegia must not be looked on as rendering the case hopeless since with prolonged rest the paralytic phenomena usually disappear entirely. Sphincter control is regained first sensation reappears and finally motor power is restored. Septic cystitis and bedsores may of course arise as complications and by their progress may cause death. As in tuberculous disease elsewhere the patient also runs the risk of developing acute miliary tuberculosis whilst other organs e.g. the lungs brain or kidney may become affected. In spite of these possibilities however the prognosis is good as regards life in cases free from complications and where suitable treatment is practicable.

The **Diagnosis** of spinal caries is rarely a matter of difficulty when the characteristic deformity exists but in the early stages when the displacement is not evident or if there is only a very slight prominence of the spinous processes it is likely to be mistaken for a simple rachitic or static curve whilst if neuralgic pain is a prominent symptom it may possibly be looked on as a case of spinal or intercostal neuralgia or as rheumatism or even be ascribed to renal affections. Tumours of the spine such as cancer or hydatid cysts syphilitic disease and ~~neural~~ ~~mal~~ ~~erosion~~ also produce symptoms somewhat resembling those of spinal caries and in adults it may be impossible from the local phenomena alone to determine which of these conditions is present but a careful consideration of the general history and of the



SPINAL CARIES (LATERAL VIEW)

Note the nearly complete destruction of the body of the first lumbar vertebra with consequent angulation of the spine

onset of the symptoms and a radiographic examination should settle the matter (Plate IX)

Treatment.—The general treatment for tuberculous cases outlined at p 187 must be instituted and carried out in as thorough a manner as possible. Every effort must be made to secure sanatorium treatment for these patients, treatment at home is usually very unsatisfactory and liable to be ineffective.

Local treatment is designed to secure the development of a suitable and sufficient synostosis with a minimum degree of deformity, and to this end three essentials must be maintained for a lengthy period, often extending into years *viz* dorsal recumbency, immobilization of the spine and, in case of need, hyper extension to prevent or cure deformity (Gauvain). It is obvious that these desiderata can be best obtained in special institutions where treatment is standardized and the means for securing educational advantages, etc., can also be provided, but if this is impossible, the practitioner must use his ingenuity to assist the child and must require the intelligent co operation



FIG 452—PLASTER BED (SIR H GAUVAIN)

of parents and nurses. The actual details of the methods adopted vary enormously in their minutiae, which it is impossible to discuss here, only general principles can be considered.

Recumbency and Immobilization can be secured in many different ways. Thus (1) The patient is kept in bed lying on his back without a pillow, and with sheets passing over the trunk and thighs secured by sandbags on either side and between the legs. If thought necessary, extension by weight and pulley may be added, together with counter extension from above by a weight attached to a chin strap and occipital band, which are united just above the ears. For children a weight of three pounds attached to each of these usually suffices to tire the muscles and prevent serious deformity. The child is kept lying down in this way until all signs of active disease have disappeared. In cervical disease the head and neck must also be secured with sandbags, or a plaster bed to include the head and neck may be utilized, or even a box splint for the head with a back board attached may be employed.

(2) A double Thomas's splint is employed by some, or a Bradford's

abduction frame but in institutions the Berck board and jacket, or some modification of it, is most commonly utilized.

(3) Immobilization in plaster is used by some surgeons from the earliest stage, either in the form of a jacket or a plaster bed (Fig 452).

Where a plaster bed is used, the patient is fitted with a vest and turned on to his face. Felt or dress-maker's wadding, is then placed over the whole back, buttocks and thighs. Plaster bandages are applied so as to form a mould over the whole back, and reaching round to the flanks and side of the chest strengthened when necessary by bands of plaster bandage. The mould is then removed and trimmed, the edges being made firm by strips of adhesive plaster. It is allowed to dry and extra padding with gamgee tissue applied.

Hyper extension may be secured in any of these various methods without difficulty by the insertion of suitable pads beneath the spine, or by dropping the upper part of the bed in such a manner as will tend to open up the curve. When the deformity has not appeared or is comparatively slight there is little risk in this manoeuvre, although it must be remembered that in itself it delays healing, but under suitable conditions when the child is being trained and educated this is not a matter of great importance. But when the deformity is severe and involves a considerable number of vertebrae, the attempt to undo the kyphosis ought only to be undertaken by specialists who have a trained band of assistants to help them.

After the active disease has come to an end and repair is being established, as indicated by complete disappearance of pain increasing weight and absence of temperature as also by radiographic examination the time has come for considering the question of allowing the patient to walk. This can only be permitted if the spine is satisfactorily supported and to

effect this the application of a *plaster jacket* is perhaps the most satisfactory plan. If the disease exists in the lower dorsal region the jacket must extend from the axillæ to just below the iliac crests, if situated above the mid-dorsal region the head also must be immobilized by the formation of a plaster collar (Fig 453). If the disease is in the



FIG 453.—PLASTER JACKET APPLIED FOR TUBERCULOSIS CARRIES OF UPPER DORSAL SPINE ILLUSTRATING FIXATION OF HEAD AND NECK BY A COLLAR AND METHOD OF LIGHTENING THE JACKET BY CUTTING OUT A PORTION (SIR H. GALVAIN)

lumbar region the jacket may be applied with the patient in the horizontal position but above this level the patient must be vertical so as to extend the spine. This is best secured by suspending him by means of a bridle attached to the head in a tripod or gallows and the toes may be allowed to touch the ground. The jacket may be reinforced to meet particular strains but should always be subsequently lightened by cutting away unnecessary portions *e.g.* over the abdomen.

Some authorities prefer to use celluloid jackets instead of plaster and certainly they are cleaner and more durable. Others employ a brace instead of a jacket in these later stages of the case and perhaps among the most satisfactory is *Taylor's brace* (Figs 454-455). Should the cervical or cervico-dorsal region be involved a ring or collar

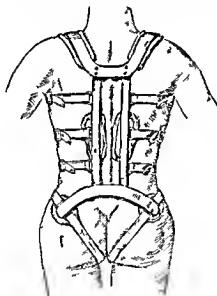


FIG 454—TAYLOR'S BRACE
(POSTERIOR VIEW)

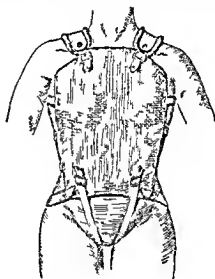


FIG 455—TAYLOR'S BRACE (ANTERIOR
VIEW) WITH LEATHER APRON APPLIED

to support or carry the chin in a suitable position of extension and fixed by a vertical rod to the brace must be added to the apparatus.

There has been much discussion as to the place and value of *Albee's Operation* in the treatment of tuberculous spines. Not a few surgeons who have had abundant opportunity of seeing it and its results do not recommend it and amongst these may be mentioned Sir Henry Gauvain others still practise it. Obviously it is possible by this means to secure immobilization of the affected area of the spine by the introduction of an internal splint and this should be of value. But it must not be forgotten that the spine though rigid is not healed and that the absorption of the graft or its fracture may lead to subsequent deformity. It is generally agreed that it should never be attempted in children under eighteen years of age and never in the

painful and after a time some slight deformity of a localized kyphotic or scoliotic type may appear. The reparative changes following on the injury involve a certain degree of congestion of the body of the vertebra rendering it incapable of sustaining the superincumbent weight of the trunk and hence it crumples up to some extent the actual result being governed by the position and severity of the lesion until the patient is given sufficient rest the pain will persist and deformity may increase. Treatment involves the most careful radiographic examination of the spine and its immobilization by suitable apparatus. A slight displacement of the cervical vertebrae may justify an attempt to reduce it by manipulation under an anæsthetic or even an open operation to fix the vertebrae by a bone graft of the Albee type (p. 803).

Painful Sacralization of the fifth lumbar vertebra is the term applied to a painful condition of the sacro iliac region of one or both sides usually attributable to strain. It is primarily due to an elongation and enlargement of the transverse process of the fifth lumbar vertebra which encroaches on articulates with or even fuses with the lateral wing of the sacrum or adjacent ilium. Slight lateral flexion of the spine in such a case may pinch the tissues between the bones or strain the ilio lumbar or other ligaments or even compress the anterior root of the fifth lumbar nerve which passes through this interval. The pain produced is of variable type often simulating sciatica and sometimes renal colic. There is always a tender spot just above the sacro iliac joint and the pain and tenderness are both improved by rest. Radiography is a most important adjuvant in diagnosis so as to ensure the absence of a urinary cause for the pain. Treatment consists in rest the support of a pelvic band and local diathermy if these fail manipulation under an anæsthetic frequently gives relief open operations are usually unsuccessful although pain may be lessened for a time.

VI Spondylitis Deformans is the term applied to a condition of the spine which results in rigidity and kyphosis. It is seen most frequently in old people who become bent and shorter than formerly but it also develops in those who have had to follow laborious occupations especially in the bending position and hence is not uncommon in country workhouses and infirmaries amongst those who have had to live and work in the fields or mines. It is akin to osteo-arthritis and characterized by very similar anatomical changes. The spine is stiff and rigid (hence the name poker back sometimes applied to it) and this results from absorption of the intervertebral discs from synostosis of the vertebral bodies sometimes with the formation and interlocking of osteophytes and especially from ossification of the spinal ligaments. Pain is often a marked feature of the case and is then due to irritation of nerve roots. A large portion of the spine is usually involved and general kyphosis is the result. Two chief varieties have been described (a) Von Bechterew's variety is one in which the upper cervical and dorsal regions are mainly involved producing a limited kyphosis with flattening of the chest and fixation of the ribs. In many of these cases evidences are present of degenera-

tive changes in the posterior columns of the cord and of irritation of the nerve roots (b) The Strumpell Marie type sometimes known as *spondylose rhizomélisque* is characterized by the affection first attacking the lower portion of the spine but it also involves the hip and shoulder joints. In both forms there is a gradual extension of the process through the whole length of the column and finally it attacks the articulations between the ribs and the vertebrae when these become fixed the respiratory movements are considerably impaired and hence death is likely to ensue from pulmonary disease. Treatment must follow along the lines laid down for osteo arthritis.

Tumours of the Spine are usually malignant in character and most commonly secondary to cancer or sarcoma elsewhere. Cancers of

the breast and prostate are very likely to metastasize in the spine and gross deformity may result (Fig 456). Simple tumours such as chondroma osteoma and hydatid cysts occur as also primary sarcoma. The chief symptoms are severe and localized pain which is constant and unrelieved by rest in the recumbent posture together with early excurvation and paraplegia. Deformity is however by no means constant. Neuralgic pain and motor spasms due to involvement of the nerve roots may considerably aggravate the patient's sufferings. These phenomena manifesting themselves in an adult should always suggest the presence of a morbid growth and the more rapid the onset, the more likely is a diagnosis of malignant disease. Treatment necessarily is but rarely feasible although an exploratory operation is quite justifiable if the disease is primary and the patient not profoundly cachectic.

Quite recently cases have been reported in which spinal compression has been caused by enchondrosis of the intervertebral fibro cartilage. Such a tumour is probably due to a herniation of the nucleus pulposus through the annulus fibrosus (Fig 457). Over sixty cases have now been reported and it is important that such a condition should be recognized. Quite often a history of trauma may be obtained.

Intermittent root pains over a long period (Fig 458) followed by signs of spinal compression is quite often the clinical picture, succeeded by weakness and sphincter troubles. As a rule the shorter the duration

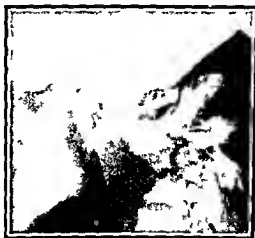


FIG 456—SKIAGRAM OF SECONDARY CARCINOMA IN THE CERVICAL SPINE

The primary growth was in the prostate. There is gross destruction of the upper cervical vertebrae.

of symptoms the better the prognosis. Laminectomy and curettage of the soft tumour from the posterior surface of the vertebral body are required.

Tumours of the Spinal Cord and Membranes develop in several situations and the symptoms are thereby somewhat modified.

(a) Outside the spinal dura (extrathecal) lipoma and sarcoma are here most often seen and the symptoms of cord pressure such as loss of power and sensation are preceded by those of spinal irritation e.g. neuralgic pain increased on movement, and are often limited for some time to one side. Multiple neuro-fibromata of the nerve-roots are by no means uncommon. (b) They may grow inside the dura mater (extramedullary intrathecal) and thus produce symptoms of cord pressure and meningeal irritation concurrently. Fibroma endothelioma and gumma are the commonest forms of neoplasm in this situation. (c) From the spinal cord itself (intramedullary) glomata and vascular tumours may originate. The symptoms are those of paraplegia com-

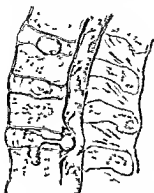


FIG. 42.—HERNIATION OF THE NUCLEUS PULPOSUS PRODUCING COMPRESSION OF THE SPINAL CORD.

bined with some localized and referred pain or tenderness, and either bilateral from the start, or sometimes of the crossed type, anæsthesia being marked on one side of the body and paralysis and hyperæsthesia on the other i.e. on the side of the tumour. The exact localiza-

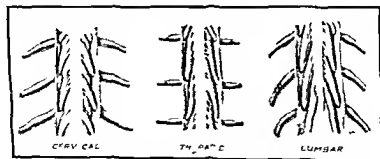


FIG. 42S.—DRAWING TO SHOW THE INTRADURAL AND EXTRADURAL COURSE OF THE POSTERIOR SPINAL ROOTS.

tion of the tumour is of great importance, and assistance can be derived as to its level by the introduction of Ipiodol* into the sub-

* Ipiodol is a colloidal solution of iodine in oil of poppy in the proportion of 0.34 cgm. of iodine to 1 c.c. of the oil. It is non-toxic and unirritating and opaque to X rays.

arachnoid space above the growth. The fluid (1 to 15 c c) is slowly injected after cisternal puncture. If there is a spinal block the level of fluid is determined by X rays. The introduction of air has also been used but is not so satisfactory as lipiodol. Although the oil is said to be non toxic and unirritating a number of cases of chronic meningitis have been attributed to it and its use should be limited to those cases in which there is difficulty in accurate localization.

An examination of the cerebro spinal fluid below the level of the lesion is of the utmost importance in these cases. Yellow coloured fluid (xanthochromine) with a high percentage of albumen and increased globulin is pathognomonic of tumour of the spinal cord. Examination of the pressure of the fluid above and below the lesion is also of great assistance. Manometers introduced by cisternal and lumbar punctures should show similar variations in pressure on compression of the jugular veins coughing etc. If however there is a spinal block the variations in pressure will differ (Queckenstedt).

A large proportion of spinal tumours are amenable to surgical extirpation. The possibility of the disease being syphilitic in origin must not be overlooked but a negative Wassermann reaction in both blood and cerebro spinal fluid is good enough evidence to disprove this. The cord is exposed by laminectomy (p 804) after localization has been determined. A minimum of three laminae should be removed and the search for the tumour initiated by careful examination for an extradural cause of compression. Extradural tumours compress the spinal cord much less and more evenly than intradural ones (Fig 459).

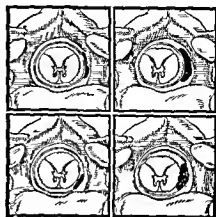


FIG 459

The two upper drawings depict how an extradural tumour compresses the cord while the lower ones show the compression caused by an intradural tumour.

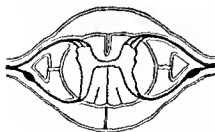


FIG 460—A TRANSVERSE SECTION OF THE SPINAL CORD AND ITS MENinges SHOWING THE POSITION OF THE LIGAMENTUM DENTICULATUM

Before the dura mater is incised it should be gently palpated up and down for any irregularity which might be an underlying tumour. An absence of pulsation of the cord at the site of or below a tumour may be of help to the surgeon in revealing its situation (Fig 460).

The commonest situation for the tumour is posterior or posterolateral but if none is found the cord must be rotated by traction on a ligamentum denticulatum (Figs 462-463). Posterior nerve roots may require section in order to expose and remove the tumour. If a tumour is not found in the area of cord exposed more laminae should be removed. There is always a tendency for the exposure of the spinal cord to be made too low and it is a good plan to remember that the lowest lamina to be removed should be at the level of the highest root involved. The existence of dumb-bell tumours should be remembered and the removal of one portion only of such tumours

avoided. These dumb-bell tumours are partly intradural and partly extradural.

Intramedullary tumours are generally irremovable. When dealing with this type of tumour a two-stage operation should as a rule be performed. In the first a longitudinal incision is made into the spinal cord immediately over the tumour which can be recognized by the oval enlargement of the cord (Fig 464). At the second operation in ten to fourteen days time partial extrusion of the tumour may have taken place and it may then be removable. It is essential in the case of intramedullary tumours to follow the operation with an intensive course of deep X-ray therapy (Fig 465).

The operative results of tumours of the spinal cord are good owing to the high proportion of simple tumours (50 to 70 per cent) being

capable of total removal and if the case has not been left too long before exploration there is complete recovery from paralytic symptoms.

Tumours of the Cauda Equina are generally meningiomas. The clinical picture may vary according to the site and extent of the compression. Pain is the earliest and most constant symptom and it is frequently diagnosed as sciatica. The pain is of a dull aching character and is often accompanied by slight twitchings of the muscles of one or both legs. These tumours are often attached to one of the nerve roots or the membrane surrounding them (Fig 466). Cauda equina tumours can usually be removed entirely and the prognosis is excellent.

Meningitis serosa circumscripta is a condition characterized by a localized effusion within the meninges the limitation being due to

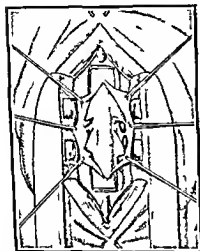


FIG 461—DRAWING SHOWING EXTRAMEDULLARY TUMOUR SITUATED ON THE POSTERO LATERAL SURFACE OF THE CORD

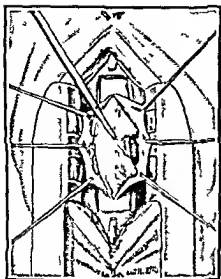


FIG 462

Division of the ligamentum denticulatum and traction on same gives a better exposure of the tumour

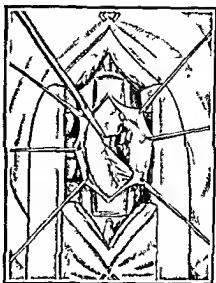


FIG 463

Quite often the tumour cannot be adequately exposed until after division of one of the posterior nerve roots in addition to that of the ligamentum denticulatum

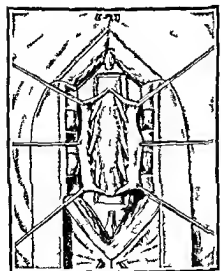


FIG 464—EXPOSURE OF INTRA MEDULLARY TUMOUR

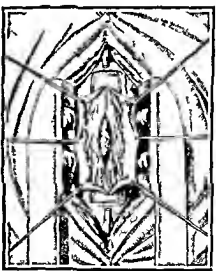


FIG 465—INTRAMEDULLARY TUMOUR AFTER INCISION INTO THE CORD

adhesions of various types which may grasp and constrict the cord or may drag it aside and thus interfere with its function. It may be the consequence of a general infection of the membranes which becomes limited or the outcome of a localized traumatism. The cerebro-

spinal fluid varies much with the completeness of the block and there does not seem to be any characteristic change. The symptoms are those of a compression paraplegia coming on in a somewhat irregular fashion. It usually affects the lower cervical or upper dorsal region and is most common in the fifth and sixth decades of life. Subjective sensory rather than motor phenomena manifest themselves in the early stages but the symptoms vary much and quickly and the pain is more widespread than in spinal tumours. Motor phenomena become more prominent in the later stages and especially weakness of the legs ending in complete paralysis. Irritative spasms may also be present not limited to one root

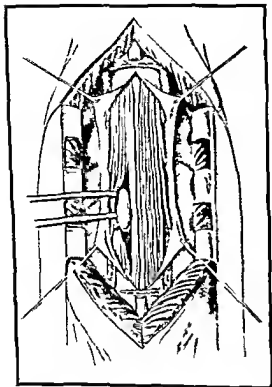


FIG 466—DRAWING MADE AT THE TIME OF OPERATION SHOWING A MENINGIOMA OF THE CAUDA EQUINA

segment. Vesical and rectal troubles do not arise till late in the case. Treatment is required either for persistence of symptoms or for spread of the trouble and consists in laminectomy with free opening of the membranes and removal of the causative adhesions so as to set free the cord.

CHAPTER XXVIII

AFFECTIONS OF THE SCALP AND CRANIUM

Affections of the Scalp

Wounds of the scalp are produced either by sharp or blunt instruments by falls on the head or by gunshot injuries. From the tension of the scalp over the cranium it is possible for a blunt weapon such as a policeman's truncheon to cause a wound nearly as cleanly cut as if made with a sharp instrument. If the wound is superficial to the occipito-frontalis aponeurosis but little harm is done if however the layer of loose cellular tissue between the aponeurosis and the pericranium (the dangerous area) is opened up and infected cellulitis (p. 69) is likely to ensue. The vascular supply of the scalp is so good that sloughing is uncommon a large portion may be torn and bruised and yet if it is carefully washed and rendered aseptic it will probably live. *Complete avulsion* of the scalp usually occurs in women from their hair being caught in machinery. The skin yields just above the ear and supra-orbital ridges and the aponeurosis is cleanly torn off. Replacement is of course hopeless when separation is complete and Thiersch grafting must be relied on for obtaining an epithelial covering.

Treatment—The hair should be cut away from the neighbourhood of the wound which is purified in the usual way the edges may be excised if badly bruised or very dirty. The iodine method of gaining asepsis (p. 273) is particularly useful in these injuries and may limit the area to be shaved. Stitches should be of a non-absorbent variety e.g. horsehair. Hæmorrhage from the scalp is often severe owing to the density of the tissues which prevents contraction and retraction of the divided vessels.

Hæmatoma of the scalp results from injuries that are not associated with solution of continuity of the surface. A similar condition is found in infants due either to injury of the head during its passage through the mother's pelvis or to its compression by forceps. Three varieties of cephal hæmatoma have been described viz (a) the *Superficial* which is confined to the dense subcutaneous tissue is necessarily small. (b) The *Subaponeurotic* occupies the loose tissue under the aponeurosis and is only limited by its attachments. A large soft fluctuating swelling forms upon which the scalp appears to float bagging down over the eyes or occiput. It is often due to fracture of the underlying bone. (c) The *Subpericranial* is limited by the pericranium dipping down into the sutures around the bone with which it is connected. Most commonly it forms over one of the parietal bones in infants presenting a soft fluctuating swelling which soon gains an indurated margin owing to a deposit of fibrin and in this

condition may simulate a depressed fracture of the skull inasmuch as the cup-like fluid centre allows the finger to sink in and touch bone below. The indurated margin however can be readily indented by the finger whilst the edge is definitely raised above the surface of the cranium and hence the sensation of a depression is only apparent. **Treatment.**—All that is required is the application of evaporating lotions. There is hardly ever any need to lay open or drain these swell in unless underlying mischief is present.

Suppuration of the scalp is of common occurrence arising usually from external infection but being occasionally due to disease of the subjacent bones. The extent of the abscesses is limited by the same anatomical features as obtain in connection with hæmorrhage. Thus a *subcutaneous* abscess is necessarily small in size owing to the density of the tissues in which it is located it arises most frequently as a result of eczema or impetigo and is often due to the presence of pediculi or to the action of irritants used in the cure of ringworm. A *subaponeurotic* abscess usually results from a penetrating wound and is associated with cellulitis. A *subpericranial* abscess is rarely seen except in connection with injury or disease of the bony calvarium and is limited to the affected region.

For Erysipelas and Cellulitis of the scalp see pp 69 and 126

Tumours of the scalp are of many types

Ordinary *traumatic aneurisms* or *arterio-venous* wounds of the temporal trunk are uncommon they rarely attain any considerable size and are readily treated by excision. A curious dilated and tortuous condition of one of the scalp arteries most often the temporal is occasionally seen and is known as an *arterial varix* it may be treated by complete excision.

Nævi of the scalp do not differ in their characters from those seen elsewhere except that when situated over the anterior fontanelle they may derive a communicated impulse from the subjacent dura and so be mistaken for a meningocele.

Cirsoid Aneurism is more frequently met with in the scalp than elsewhere and chiefly involves the auriculo-temporal region but may also spread in all directions even downwards into the neck. In a few cases it has been preceded by a naevus and sometimes there is a history of injury. A tumour of greater or less size is seen under the skin consisting of distended tortuous pulsating bluish looking vessels the arteries opening directly into cavernous spaces it is easily emptied by pressure but quickly refills. The patient often complains of headache and giddiness the skin becomes thin and atrophic the hair falls out and finally ulceration may occur the patient probably dying from hæmorrhage. The **Treatment** is eminently unsatisfactory complete excision being the ideal cure but this in bad cases is impracticable. If it be attempted the incisions should be made wide of the disease and the supplying vessels secured if possible between double ligatures before dividing them. If this precaution is not adopted frightful hæmorrhage may result. It is necessary in some cases to deal with the tumour in separate segments allowing time between the operations for the patient to recover from the loss of blood. Prob-

ably *diathermy* combined with *ligature* of the main nutrient vessels or of both external carotids holds out the best chance of success

Papillomata are not uncommon in the form of small hard warty outgrowths giving rise to but little inconvenience unless situated on some spot where the hat rests. They are easily removed

Lipomata also occur and are usually situated in front arising from the deeper layers of the scalp or from the pericranium. They generally expand laterally and are flattened. Removal is readily effected

Epithelioma also occurs arising either from an irritated papilloma or possibly in connection with a sebaceous cyst. As soon as a diagnosis is made the growth should if possible be *extirpated* and the resulting raw surface may be either left to granulate or dealt with by Thiersch's method of skin grafting

Neuro-fibromatous growths sometimes involve the scalp giving rise to irregular nodulated masses of soft tissue which may even hang around the root of the neck in large coils. It is then known as a *pachydermatocele* (p 215). Excision is the treatment if the mass is not too large

Sarcoma of the scalp is uncommon apart from a similar affection of the underlying bones. It develops as a large fleshy tumour which may pulsate or fungate and usually grows rapidly but is limited for some time by the aponeurosis of the occipito-frontalis. Treatment by a wide excision and Thiersch grafting may be possible but if the condition is at all advanced the only hope lies in the use of radium or the λ rays

Dermoid Cysts are by no means uncommon in this region their favourite situation being near the outer canthus the temple or the root of the nose. For a general description see p 236. They do not attain any great size and may not become evident till after puberty. The underlying bone is often hollowed out from a defective development of the mesoblastic tissues around them and a congenital opening may even exist through which a narrow neck passes bringing the cyst into direct connection with the dura mater. The treatment consists in removal but it is advisable to delay this till after puberty if the tumour seems at all fixed to the skull or if the bone is felt to be defective beneath it as in such cases the communication with the interior of the cranium is often shut off by that time

Sebaceous Cysts (p 460) find their most usual situation in the scalp where they are frequently multiple. Their removal is best accomplished by transfixion squeezing out the contents and picking out the cyst wall by a pair of forceps without dissection. The wound is closed by one or two stitches

Sebaceous Adenoma is most frequently seen on the scalp (p 461)

Affections of the Cranium

I Congenital Affections

1 In babies the ossification of the bones may be incomplete constituting what is known as *aplasia cranii congenita* and is due to a

cachectic condition of the mother. Occasionally a similar atrophic condition of the bones may persist through life exposing the patient to increased risk from injuries which otherwise would do but little harm.

• **Meningocele, Encephalocele, and Hydrancephalocele** consist of a protrusion of the dura mater with or without part of the brain through an opening in the cranial wall. They are due to defective intrusion of the mesoblastic tissues outside the primitive cerebral vesicle so that part of the brain or its membranes remains superficial and extracranial. They occur most frequently at the root of the nose and in the occipital region (Fig. 467) occasionally at the anterior or lateral fontanelle or at the base of the skull. A *Meningocele* is simply a protrusion of the brain membranes containing cerebro-spinal fluid. It forms a soft rounded fluctuating swelling attached to the skull by a base of greater or less size and covered by skin which may be thick and healthy or thinned bluish and translucent when



FIG. 46 MENINGOCELE OF THE FRONTAL REGION

the tumour is large. The vessels present in the skin are often dilated and nœvoid. It increases in size and tension on any expiratory effort such as coughing or crying and it may be partially reducible thus allowing the margins of the opening in the cranium to be defined. Symptoms of cerebral compression convulsions etc. are likely to be produced by such manipulation. An *Encephalocele* is a similar type of tumour but contains brain substance and pulsates almost synchronously with the heart. It is most commonly situated at the back of the skull. A *Hydrancephalocele* or *Meningo-encephalocele* is a condition in which the tumour contains both brain substance and fluid. Two varieties have been described—one in which there is a small protrusion of the brain associated with an ordinary meningocele and the other in which the fluid is contained in a cavity communicating with one of the ventricles and covered by a thin layer of brain substance. They are usually of considerable size and situated in the occipital region either above the tentorium and then possibly associated with distension of the posterior cornu of one of the lateral ventricles.

or below that structure the osseous defect extending in some cases as far as the foramen magnum and a portion of the cerebellum being within the sac

The **Prognosis** of these conditions is exceedingly grave. Fortunately many of the subjects are born dead or die soon after birth. In the more severe cases idiocy and microcephaly are not uncommon whilst sometimes hydrocephalus is present. The protrusion may increase steadily in size and finally burst causing death by meningitis or in more favourable cases it may remain stationary. In a meningocele the subsequent growth of the bones may suffice to close the communication between the interior and the tumour which thus becomes shut off and remains as a cyst like swelling with the base fixed and without pulsation or respiratory impulse.

Treatment—Most cases should be left alone but if the swelling is increasing aseptic puncture and subsequent compression may hinder the process. A simple meningocele may possibly be cured in this way but when the communication with the skull is small it is often feasible to open the sac and suture the base securely.

II Acquired Affections of the skull are atrophic hypertrophic inflammatory or neoplastic in nature.

Acquired Atrophy of the skull occurs in many forms.

(a) *Craniotabes* is a condition met with during the first year of life usually as a result of inherited syphilis (p 662).

(b) *Senile atrophy* may affect the whole cranium which becomes thinned and rarefied or it may be localized e.g. to the parietal bones constituting hollow depressions which extend antero posteriorly.

(c) Localized loss of substance may result from the pressure of tumours such as Pacchionian bodies and aneurisms from necrosis or from traumatic and operative lesions. If these are at all extensive the cerebral pulsations can be felt distinctly through the skin.

(d) *Essential Hydrocephalus* is always associated with atrophy and thinning of the cranium. It may be congenital or may commence early in life (Fig 468). It is produced in almost all cases by a distension of the lateral ventricles with fluid the result of congenital malformation or of inflammatory affections of the base of the brain. Thereby the secretion of the cerebro spinal fluid by the choroid plexuses may be increased beyond the functional capacity of the channels of exit (p 858) or the escape of the fluid from the ventricles may be prevented by pressure or obstruction or finally the communications with the venous sinuses may be blocked in which case there-



FIG 468—ADVANCED HYDROCEPHALUS

is some excess of fluid outside the brain as well as within it. The head becomes more and more distended (Fig. 469) the bones are expanded and thinned and the sutural areas increased whilst the brain is subjected to such pressure as may be incompatible with life. Fluctuation is distinctly felt and the bones may crackle under the fingers the face looks abnormally small and the eyes protrude owing to the depression of the orbital plates. *Treatment* is very unsatisfactory. Tapping of the ventricles is useless as even if a considerable amount of the fluid is withdrawn and elastic pressure subsequently maintained recurrence is almost inevitable. The only hope is to establish a free communication between the ventricular and subdural spaces so that the excess of fluid in the ventricles may escape it will be absorbed from the subarachnoid space as soon as the tension rises above the



FIG. 469.—HYDROCEPHALUS

The greatly enlarged cranium the overhanging eyebrows the staring eyes the wasted features and the attenuated body constitute a typical picture.

intravenous pressure. A silver tube should be inserted between the two spaces or a tube of decalcified bone carrying a catgut drain to be of any value the operation must be undertaken before the cerebral cortex has been so thinned as to interfere with its functional activity.

The late Sir Percy Sargent was the pioneer in this country in attacking the choroid plexuses and ablating them by opening the brain and carefully removing the plexuses but his results were not conclusive owing to the fact that his cases were extremely advanced and the operation was performed too late.

However Putnam has now perfected a technique in which the choroid plexuses are exposed and coagulated by means of a diathermy. His results clearly warrant that this mode of attack should be most frequently used and practitioners are advised that if good results

are to be obtained it is necessary that this operation should be performed before the condition becomes far advanced. In those cases in which there is a definite history of inflammation of the brain and there may be adhesions around the fourth ventricle it may be possible to open up this small canal as advocated by Dandy Fraser and Dott.

(e) By *Microcephaly* is meant a condition of diminished size of the cranial cavity due to premature ossification of the sutures and resulting from non development of the brain. It is usually associated with idiocy and possibly with cretinism. No treatment is of any permanent value.

Hypertrophic Changes of the Skull result from simple chronic inflammatory affections or from injury etc. Special types of enlargement are seen in inherited syphilis (p 662) rickets (p 664) osteitis deformans (p 670) and acromegaly (p 673). In leontiasis ossea (p 934) the cranium becomes thickened and enlarged but the cranial cavity is also encroached on constituting what is known as *concentric* hypertrophy in contrast to most of the other forms which are *eccentric* in type.

Inflammatory Affections of the Cranial Bones—The cranium is liable to any of the diseases which generally occur in bone.

1 **Acute Periostitis, or Pericranitis**, is usually infective in origin following cellulitis of the scalp it is likely to result in necrosis of the outer table.

2 **Acute Infective Osteomyelitis**, or acute necrosis consists of an acute inflammation of the diploe due to pyogenic organisms and either following an infected scalp wound or compound fracture in infective inflammation of one of the air sinuses (especially the frontal sinus or mastoid antrum) or the operation necessary for its treatment or a simple contusion of the bone in a person of low germicidal powers it may also be pyæmic in origin. The symptoms and signs are those generally characteristic of the disease being ushered in by a rigor followed by headache fever and the development of a localized œdematous swelling known as Pott's puffy tumour (Fig 501). The pericranium is stripped up by diffuse suppuration beneath it and an abscess often forms between the bone and the dura mater. Necrosis of the whole thickness of the skull is likely to follow but is usually limited by the sutures to the particular bone affected. Pyæmia and extension of the inflammation to the membranes venous sinuses or brain are the chief dangers arising from it. The prognosis is always grave even when early operative treatment is undertaken apart from operation it is almost hopeless. The *Treatment* consists in free external drainage together with the removal of the outer table in early cases to enable the infected diploe to be removed. If signs of subcranial suppuration ensue (p 882) the inner table must also be widely taken away. In the later stages necrosed bone is removed when it has been set free.

3 **Chronic Periostitis** is occasionally met with in the form of a node. If independent of syphilis it is usually the result of long continued irritation such as carrying baskets or weights on the head. *Treatment*

consists in the discontinuance of the causative irritation and there is no objection to chiselling away the node if necessary.

4 **Tuberculous Disease of the cranial bones** is not common it occurs as a primary phenomenon or more commonly is secondary to a meningeal focus. It may start in the periosteum or diploe leading to the formation of a node or perhaps to expansion of the bone and followed by supuration and caries. When of meningeal origin there is a considerable amount of erosion of the inner table and possibly some necrosis sooner or later the outer table is perforated and a subpericranial abscess forms. The amount of mischief in the outer table is no criterion of the extent of the disease within and hence a thorough exploration is necessary. The prognosis in this variety is not good unless active operative measures are taken at an early date combined with suitable constitutional treatment.

5 **Syphilitic Disease** used to be exceedingly common but is now seldom seen. It occurred usually in the tertiary stage and affected most frequently the frontal and parietal bones. It has been already described (p. 661).

Tumours of the Cranial Bones—The chief Tumours affecting the calvarium are osteomata and sarcomata.

Osteoma of the cranium (Fig. 68 p. 209) occurs as a localized overgrowth of compact bone from the outer surface of the calvarium from the inner or from both. The frontal bone and external auditory meatus are the sites of election. If arising externally a smooth rounded globular swelling is produced hard to the touch quite painless and fixed to the subjacent bone by a broad base more than one may be present. If the main growth is internal symptoms of cerebral irritation or pressure are produced. Osteomata are to be distinguished from inflammatory hyperostoses (usually of syphilitic origin) by their sharp limitation, absence of pain and slower progress, whilst osteo-sarcomata are commonly rapid in growth, painful and of unequal consistency in different parts. Treatment is rarely necessary. Small growths may be encircled in the crown of a trephine and thus removed. Large ones must be dealt with by an electric saw or burr the bone being divided just outside the dense compact tissue and thus the tumour is set free. No attempt should be made to chisel away these growths as symptoms of concussion may follow the prolonged use of the chisel and mallet against the skull.

Sarcoma of the cranium originates from either the pericranium the diploe or the dura mater.

The *pericranial* variety consists of a round or spindle-celled tumour growing from the pericranium and possibly attaining a considerable size. It may contain a certain amount of ossific deposit or the tumour remains of a soft consistency and then often pulsates. The subjacent bone is sometimes absorbed and the dura mater affected secondarily. General infection of the system follows.

Central Sarcoma commences in the diploe and spreads both outwards and inwards. In this situation however a *myeloma* may develop and simulates a sarcoma its growth however is slower and it is covered with a thin layer of bone which may crackle

beneath the fingers. It is commonly secondary to sarcoma of the kidney.

Secondary Carcinoma of the cranial bones is by no means uncommon, and may follow cancers of the mamma, thyroid body, etc. The growths are usually small and multiple, and may show pulsation. Neuralgia and persistent headache result from them.

III Traumatic Affections of the Cranium.

Contusions of the Cranial Bones apart from fracture may lead to serious results. 1 Many of the inflammatory conditions of bone just described may be originated *e.g.* if the patient is in a condition of low germicidal power, acute osteomyelitis may follow, or chronic sclerosis and overgrowth of the bone, local or diffuse, may supervene. Syphilitic or tuberculous manifestations may be similarly lighted up if the patient is the subject of either of these diseases. 2 In addition to such osseous conditions, pus may form within the cranium outside the dura mater (*subcranial abscess*, p. 882) and necessitate operation. 3 The dura mater may be detached by a simple contusion, leading to meningeal hæmorrhage (p. 878). 4 Any of the cerebral lesions detailed hereafter may be produced. Contusions of the cranium must obviously never be treated lightly, even when they are associated with unbroken skin, much more are they serious when open, owing to the risks of infection.

Fractures of the Skull may be described for convenience under the following headings: *Fissured Fractures of the Vault*, *Fractures of the Base* (usually fissured), and *Depressed or Punctured Fractures*.

1 **Fissured Fractures of the Vault** are always due to external violence, direct or indirect. In the former case the skull first yields at the injured spot, but the fissure may extend from it for some distance, in the latter the fracture results from the yielding of the skull when compressed beyond its natural limits of elasticity (Fig. 470).

A closed or simple fissure gives rise to no symptoms indicating its presence with certainty. There may be some amount of superficial ecchymosis and tenderness, but nothing more definite. When open, the line of fracture may be seen as a red streak, or even felt with the finger as an irregular ridge. It consists of a single longitudinal fissure, or may be starred, if uncomplicated, it is of but little importance, and needs nothing beyond general treatment and the maintenance of asepsis. Occasionally, however, a mass of protuberant callus forms on the inner aspect of the cranium at the site of fracture, or the dura mater becomes thickened by organization of effused blood, either of these lesions may give rise to chronic headache or discomfort, or even to traumatic epilepsy or insanity (p. 913).

Traumatic Cephal-hydrocele is the name given to a rare condition following simple fractures of the vault, especially in children. It is characterized by the formation of a fluid swelling under the scalp, which pulsates synchronously with the heart beat, and has a definite impulse on any expiratory effort, it varies in size from time to time and is sometimes partially reducible. It contains cerebro-spinal fluid, and communicates with either one of the lateral ventricles or the

subarachnoid cavity. In one case it was proved on operation to be connected with an arachnoid cyst due to a localized subarachnoid hemorrhage. Probably it is wise to operate on these cases as they will not get well of themselves.

2 Fractures of the Base of the Skull are almost always fissured and only occasionally punctured or depressed.

Causes.—(a) Violence may be directed to the vertex or to some part of the cranial convexity as from a blow or fall upon a hard substance. There has been a good deal of discussion as to how a fall on the vertex causes fracture of the base. Two main theories hold the field each



FIG. 40.—X RAY OF FRACTURE OF THE VAULT OF THE SKULL IN A CHILD

being probably responsible for a certain number of cases. (1) Aran's theory of *irradiation* maintains that a fracture of the base is always due to direct extension of the fissure from the injured vertex a proposition probably quite true in many cases but insufficient to explain all. (ii) A more recent idea known as the *bursting or compression theory* is based on the fact that the cranium is not a solid and totally unimpressionable body but is highly elastic as has been proved by the observation that hair and even pieces of skin have been found matted in a fissured fracture of the vault which had evidently gaped open and closed again. Moreover it is very irregular in shape and of very variable strength and density and the base is weakened by the

presence of numerous foramina for the passage of spinal cord, vessels, and nerves, the base is also less elastic than the vault. Severe compression necessarily diminishes the diameter of the skull along the axis of greatest pressure, making it bulge in other diameters, if this exceeds the limits of elasticity of the bone, a fracture must result. Most commonly the lines of fracture are parallel to the direction of the compressing force, the bone thus bursting open along its convexity (fracture by bursting) less frequently it gives way at right angles to the direction of the force (fracture by compression). Inasmuch as the force is transmitted equally in all directions, the weakest and least elastic part is always most likely to give way, *viz* the base (b) *Direct or indirect injury* to the base of the skull is undoubtedly the cause of a certain number of fractures, and some of these are depressed, and not fissured in character. Thus, the point of an umbrella or a stick may be thrust through the upper wall of the orbit, or up the nose through the cribriform plate of the ethmoid, the condyle of the jaw may be driven through the glenoid cavity into the



FIG 471.—DIAGRAM SHOWING THREE COMMON TYPES OF FRACTURE OF THE BASE OF THE SKULL

middle fossa by a blow on the chin, direct injury from a fall or a stab may penetrate the occipital bone, whilst a gunshot wound in the mouth is another illustration of this kind of injury. (c) The *impact or resistance of the vertebral column against the occipital condyles* produces fractures in the posterior fossa which radiate from the foramen magnum, and may even occasion a ring shaped fracture around it (Fig 472). They result from falling on the vertex into a soft mass *e.g.* a bale of wool, or by alighting from a height on the heels or nates.

The fracture may run in any *direction*, longitudinal, oblique, transverse, etc., according to the direction of the compressing or fracturing force, and it may affect any part of the base, either being limited to one of the fossæ or involving all, it may follow the sutural lines in part, but it is no uncommon thing to see even the dense petrous bone traversed by a fissure (Fig 471). Naturally, transverse fractures are more likely to be limited to one of the fossæ, whilst a longitudinal fissure may involve them all.

Some fractures of the base of the skull are closed in nature, but the majority are *open*. In the anterior fossa the fissure extends through

the cribriform plate and nasal mucosa and then lays open the nose or a communication may be established with the external air through a penetrating wound in the orbit or through the ethmoidal or sphenoidal sinuses. In the middle fossa a fracture through the base of the pharynx opens the roof of the naso-pharynx or the fracture may involve the tympanic cavity. In the posterior fossa the basi-occipital may be broken and again the naso-pharynx opened although the fracture here is more commonly closed.

Fractures of the base of the skull though very serious are by no means necessarily fatal and since the introduction of anti-septic methods the results have immensely improved. The main dangers to be apprehended are

(i.) Damage to the base of the brain including the pons and medulla especially in cases where the foramen magnum is splintered from the impact of the spine against the condyles (ii.) hemorrhage arising either from the venous sinus or from the meningeal or cerebral arteries and (iii) infective meningitis due to the fact that the injury not only fractures the bones but also tears the dura mater a grave addition to an open fracture.

The Signs of a fractured base are sometimes exceedingly equivocal but for convenience may be arranged under four heads.

- (1) Signs of severe cerebral mischief such as concussion of the brain and prolonged unconsciousness
- (2) Hemorrhage manifests itself in various directions according to the situation of the fracture

In the anterior fossa there may be free bleeding from the nose owing to the fracture extending through the cribriform plate of the ethmoid but a portion of the blood may pass backwards into the pharynx and being swallowed is perhaps subsequently vomited. More often however the line of fracture runs across the roof of the orbit causing escape of blood into the areolar tissue of this cavity. The ecchymosis shows itself as a gradually developing subcutaneous distension involving the lower lid bluish purple in colour at first but passing later through the other stages of a bruise there is probably

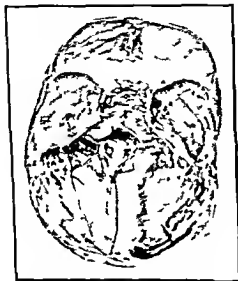


FIG. 42.—BASE OF SKULL OF A CHILD AGE TEN SHOWING FRACTURE INVOLVING POSTERIOR FOSSA

no contusion of the skin as in the ordinary black eye which is at first reddish purple the ocular conjunctiva is considerably involved but the effusion rarely extends above the cornea and its posterior limits cannot be seen. The bleeding usually arises from laceration of the dura mater and bone but when abundant may come from the cavernous sinus and the eye may even be pushed forwards (proptosis) in some cases pulsation is to be felt within the orbit and then a traumatic orbital aneurism or aneurismal varix is present.

In the *middle fossa* the blood may enter the nose or mouth a part being swallowed but more commonly it escapes from the ears. Examination of the naso-pharynx and ear should always be made in serious head injuries and if practicable by a specialist. It may be possible to see blood trickling in a thin stream from the Eustachian tube when there is no external evidence of bleeding or the blood may collect in the tympanic antrum and be seen through an intact membrane as a dark bluish black collection. If the bleeding is abundant it probably comes from one of the vascular channels at the base of the skull but if only slight in amount and of short duration it may be induced by any of the following lesions as well as by a fractured base viz (a) A simple rupture of the membrana tympani (b) separation of the cartilage of the pinna with tearing of the lining of the external meatus (c) fracture of the anterior and lower part of the tympanic plate as by a blow on the jaw which drives the condyle forcibly against it.

In the *posterior fossa* the bleeding is usually subcutaneous showing itself around the mastoid process and extending downwards amongst the muscles at the back of the neck.

(3) *Discharge of cerebro spinal fluid* (p 853) is an indication that a communication exists with the subdural space. The fluid may be discharged from one or both ears but has also been met with coming from the nose or cranial vault when from the ear the dura mater has probably been laid open through the prolongation which accompanies the auditory nerve in the internal meatus by a fracture traversing the petrous bone. At first it is probably blood stained but soon becomes quite clear. The amount discharged may be small but not unfrequently it comes away in large quantities soaking the pillow and dressings and indeed can sometimes be caught in a test tube as it trickles from the meatus.

(4) Escape of brain substance from the ear has also occurred in a few instances most of them fatal.

(5) *Lesions of the nerves* issuing from the base of the skull are occasionally produced. For symptoms etc see Chapter XVII. The nerve most commonly involved is the facial as it passes through the aqueductus Fallopi the paralysis may develop either immediately or more often about the second or third week after the injury disappearing in about a month and then evidently due to its implication in the callus (p 412). A certain amount of deafness is often associated with it from injury to the auditory nerve. Fractures through the anterior fossa are often followed by loss of smell from injury to the olfactory nerves.

The Prognosis of a fractured base has much improved during recent years as a result of the application of antiseptics to the auditory meatus. If the patient escapes death from acute cerebral complications the bones of the skull unite rapidly, and a good result may be expected although troublesome sequelæ may follow from the development of various types of safe cerebral mischief, or from the injury sustained by nerves or vessels or from their compression in callus or new bone.

Treatment.—Seeing that the chief danger to the patient arises from infection of the meninges, the greatest care must be directed towards preventing the access of bacteria. Unfortunately, it is impossible to apply dressings to the naso-pharynx, or even to wash it out thoroughly with antiseptics, and the only satisfaction about such cases is that the rareness of the loss of the cerebro-spinal fluid suggests that the membranes of the brain are not very often damaged in that situation whilst it has also been shown that in the majority of cases the upper part of the nasal cavity is aseptic. With the ear, however, things are very different. The pinna should be thoroughly cleansed, and the meatus if no previous otorrhœa existed, should be gently but thoroughly irrigated with warm 1 in 20 carbolic lotion or filled with 2½ per cent tincture of iodine, which is then washed out with alcohol, any cerumen being taken away with forceps if possible. A large pad of sterilized gauze and wool should be bandaged over the ear and head and replaced as often as necessary. The presence of chronic otorrhœa is obviously a serious complication, and may determine grave septic infection of the meninges. Opinions differ somewhat as to treatment under these circumstances. Some say that all such cases demand an immediate complete mastoid operation so as to protect the lesion in the base of the skull. Others, probably with justice suggest that such a procedure may light up infection by interference and counsel watchful delay, only opening up the mastoid process should symptoms suggest its necessity. It must not be forgotten that the escape of cerebro-spinal fluid through the ear is likely to wash infective material outwards and not inwards.

Beyond this the treatment of fractured base is directed to the cerebral condition and does not differ from that usually applied to head injuries: viz cold to the shaved head, a smart calomel purge to start with low diet and absolute quiet in a dark room. In the absence of signs of cerebral irritation or inflammation, viz increased rapidity of pulse persistent headache, giddiness, etc., the patient may be allowed to sit up in bed at the end of a week, and his diet is gradually increased but he should not be permitted to get out of bed for a fortnight and even then must keep very quiet, and not think of returning to work for six or eight weeks.

For the later management of head cases, see p 876

3 **Depressed or Punctured Fractures** usually involve the vault of the cranium, and are due to direct violence, either from a fall or blow, causing a closed or open fracture, or from a penetrating injury occasioning a punctured fracture (Fig 473). In both cases there is often a considerable amount of comminution.

It is quite possible for the outer table to be broken and depressed without any injury to the inner where an air cavity exists in the bone, or if the diploe is very thick thus, the bone may be driven in over the frontal sinus without injury to its inner wall or the mastoid may be similarly affected. The inner table has also been broken and fragments even separated, as a result of a simple depression without fracture of the outer table this rarely occurs in adults but is not uncommon in children. Amongst the latter it is also possible for a considerable depression to exist without any fracture of the inner table.

More usually both inner and outer tables are involved and when this is due to force reaching it from without, the inner table is always more damaged than the outer especially in the punctured



FIG 473 —DEPRESSED FRACTURE OF SKULL IN A CHILD

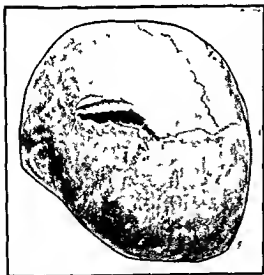


FIG 474 —DEPRESSED FRACTURE OF SKULL SEEN FROM WITHOUT

variety (Figs 474 and 475). When however the force is applied from within as by a bullet which has traversed the brain the outer table suffers more than the inner. The causes of this condition are similar from whichever side the force comes but need only be considered when the violence acts from without. (a) The inner table is less supported than the outer having merely the soft brain and dura mater within and hence is extensively splintered just as a nail driven through an unsupported piece of wood causes ripping up of its under surface.

(b) The loss of momentum of the fracturing body will assist this, the greater the momentum of a penetrating body, the more cleanly it cuts, a smaller momentum breaking or splintering rather than cut-

tung of course a considerable amount of force is expended in penetrating the outer table (c) The debris caused by the injury to the outer table will add to the bulk of the penetrating body and its wedge-like action still further increases the injury to the inner table (d) All force tends to radiate and diffuse itself from the spot struck and hence if the outer table is first injured the force will be disseminated over a more extensive area of the inner

The Symptoms and Signs arising from a depressed fracture vary widely in their nature and are partly due to the injury inflicted on the bone partly to that sustained by the brain whilst the infection or not of the wound is of the gravest significance

Locally when an external wound is present one sees blood or cerebro-spinal fluid escaping or even brain substance protruding



FIG 475—DEPRESSED FRACTURE OF SKULL SEEN FROM WITHIN

The damage to the bone may be seen or felt and the extent of the depression or comminution thus ascertained. When there is no external wound a hæmatoma of variable size forms under the scalp more or less obscuring the fracture. The character of the lesion is a matter of considerable importance from a prognostic point of view. When the bone shelves evenly in all directions a *pond* or *saucer* fracture is said to be present and this is tolerably amenable to treatment when however the depression is sudden and complete the detached portion lying below the level of the rest of the bone it is termed a *gutter* fracture and the prognosis is increasingly grave. The two forms are however often associated. Necessarily considerable variations are met with in this type of fracture according to the nature of the injury and the means by which it was inflicted. Thus

if it is due to a fall on the vertex, there is often a ragged, irregular scalp wound, through which the depression can be seen or felt, if caused by the puncture of a sharp tool, such as a pickaxe, there is only a small external opening corresponding to the hole in the skull in which the point of the instrument may be found embedded. A slicing cut with a sabre or hatchet produces a clean incision through the scalp, together with a linear groove in the skull perhaps somewhat bevelled, which may or may not penetrate its whole thickness. Sometimes detached portions of the skull are raised above their ordinary level, constituting an *elevated fracture*, it is usually associated with depression of surrounding parts.

In a *closed depressed fracture* the patient usually suffers from concussion, followed almost immediately by compression the latter due in part to the depressed bone, but mainly to exudation of blood and bruising of the brain, if this is at all extensive and remains unrelieved, a fatal result quickly follows. Where, however, the depression is but slight, the symptoms of compression may be absent or not marked and the patient recovers, perhaps to become the subject of chronic headache, traumatic epilepsy or insanity at a later date, induced by the irritation of the dura mater and of the subjacent cortex. If the depressed fragments irritate the motor area, convulsions, spasms or paralysis may be thereby induced.

In an *open depressed or punctured fracture* the immediate effects are not necessarily severe, the patient perhaps not even suffering from concussion, though brain substance presents in the wound, the more limited the spot injured, the less the concussion. The explanation of this fact is that the blow has expended its force in fracturing the cranium, and hence does little harm to the brain, in the same way that a watch may receive but slight damage from a fall if the glass is broken, whilst if the latter remains intact the works are liable to suffer.

Left to itself, such a fracture is sure to become *infected*, and inflammation of the bone, brain, or membranes will follow.

Septic osteitis leads to necrosis of the fragments, which may be seen lying dead and yellow at the bottom of the wound, whilst the inflammation may either spread along the diploe to the surrounding bone, causing extensive necrosis with pyæmia, or between the bone and the dura mater, leading to a subcranial abscess.

When once the dura mater has been penetrated, inflammation is liable to spread to the meninges, and then a diffuse or localized suppurative meningitis accompanied or not with a localized suppuration of the brain, will ensue. Even if the dura mater has not been opened by the injury, the irritation of depressed spicules of bone and the presence of a purulent exudation often lead to its ulceration at a later date. If there is a free external opening, allowing a ready exit to the discharge, and thus preventing tension, the process may be quite limited, and compression of the brain or diffuse septic meningitis is avoided, but if the fragments of bone are locked together as well as depressed, and the external wound is small, retention of inflammatory products may lead to their diffusion, and the symptoms of compression will soon become evident. A hernia cerebri may also form subsequently.

The Treatment of these cases is based on the belief that a patient runs greater risk from leaving a slight depression unrelieved than by making even what may prove to be an unnecessary exploration. The object of the operation is to protect the dura mater if uninjured from the irritation of the sharp edges of depressed fragments, to free the brain from the pressure of the depressed bone or of effused blood and if the dura mater is torn to remove hopelessly damaged brain

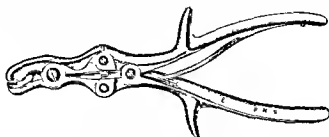


FIG. 46—A USEFUL TYPE OF SKULL FORCEPS

The multiple joints make its action easy and no force is required when using this instrument

substance or protect it as far as possible from the risks of infection or to provide free drainage if infection is already present

The indications for operation may be epitomized thus

- (i) In all punctured fractures operate
- (ii) In all open depressed fractures operate
- (iii) In closed depressed fractures In adults always operate in children if gutter shaped operate if pond shaped wait for symptoms unless the fracture is a bad one

When an operation has once been decided on the sooner it is undertaken the better. The scalp should be shaved and thoroughly purified. An anæsthetic may or may not be given according to the condition



FIG. 477—ADSON'S ELEVATOR

A very useful instrument in elevating small portions of bone

of the patient if he is comatose he requires no anæsthetic if he is partially sensible local infiltration anæsthesia should be employed or gas and oxygen chloroform is especially undesirable. In a *closed depressed fracture* a flap of scalp is turned down so as to avoid the presence of a cicatrix over the lesion in the bone. Having cleared away blood-clot and exposed the fracture some loose fragments may be exposed and the removal of these may permit of the introduction of an elevator (Fig. 477) if more room is required skull forceps

(Fig 476) must be used to enlarge the opening. If there are no loose fragments an opening must be made with a trephine. The centre pin is placed upon some firm undepressed bone as near the margin as possible (Fig 478) and a circle of bone removed. An elevator can now be introduced, the fragments prised up into position and the condition of the inner table investigated. Care must be taken in removing loose fragments not to tear the dura mater by injudicious violence especially is this the case when the fracture lies over one of the venous sinuses. Sufficient bone must be taken away to allow the whole of the damaged area to be examined.

If the dura mater has been injured brain substance mixed with blood may escape as soon as the flap is raised. When the bone has been dealt with any protruding portion of cerebral material is removed and the dura mater lightly stitched across the gap.

In an open depressed fracture the conditions vary much and the surgical treatment must be modified to meet the requirements of the case. The general plan of treatment for penetrating gunshot wounds may be taken as a model. All patients injured in this way should be X rayed prior to operation so that the surgeon may know exactly whether or not fragments of bone have been driven into the brain and some idea as to their depth may be reached. Local infiltration anaesthesia by novocain and adrenalin is to be preferred but gas and oxygen may be administered after a dose of morphin or ether by Shipway's apparatus. Chloroform is contra indicated.

After shaving and purification of the scalp the margins of the wound should be excised and provision made for effective exposure of the bone either by turning down a flap or by enlarging the original wound. The latter plan is that recommended by Cushing, viz to make three radiating incisions which shall extend out sufficiently far to allow large flaps to be raised thereby laying bare the bone around the lesion such flaps can be brought together later on with but little tension and securely sutured.

The opening in the dura must be handled with the utmost consideration. If torn and dirty the margins may be carefully trimmed but as little tissue as possible must be removed since protective adhesions may thereby be broken down or cortical vessels injured.

The brain itself is gently explored and foreign bodies or fragments



FIG 478—ENLARGED FRACTURE OF SKULL SHOWING SPOT FOR APPLICATION OF TREPHINE.

of bone driven in must be removed. In this stage gentle irrigation with sterilized normal salt solution at a temperature of about 110° F will be useful both to wash away disintegrated brain and blood and to assist in hæmostasis. A large wound may permit of the entrance of a finger and fragments may be removed by forceps but for a small penetrating wound a soft catheter should be passed down the track, and softened brain and foreign bodies or bits of bone may be removed by suction. Disintegrated brain is removed by this means normal brain tissue is not affected.

Finally it is recommended by Cushing that the track should be injected with a small quantity of the oily solution of dichloramine T and this is also gently applied to the margins of the wound in the dura mater which is completely closed in suitable cases or partly closed in others. A drainage tube or gauze pack may be placed down to the opening in the dura but not through it. The scalp incisions are completely closed unless drainage is employed the more complete and thorough the operation the less necessary is drainage and whenever possible it should be avoided.

Hæmorrhage from the cortex is sometimes troublesome and if the bleeding vessel cannot be secured a small fragment of muscle should be pressed over the bleeding point for some moments till it sticks and then the bleeding will have ceased.

In civilian cases where a foreign body has been introduced or a septic penetrating body such as the point of a pickaxe inflicted the wound the above described procedure will be required. When however the lesion is not of this type but inflicted by a blunt non penetrating instrument such as a poker this elaborate procedure may be simplified and after removing loose fragments of bone and brain the surface is washed over with hot salt solution and covered up with dura mater with or without drainage as seems desirable.

In all cases the patient should be confined to bed with the head slightly raised on a single pillow and the general rules suitable to head injuries followed.

The symptoms and treatment of the intracranial complications of head injuries are dealt with in the next chapter.

CHAPTER XXIX

AFFECTIONS OF THE BRAIN AND ITS MEMBRANES

Cranio-Cerebral Topography

It is scarcely necessary or desirable in a student's manual to deal exhaustively with this subject. The main facts can alone be referred to and larger textbooks of operative surgery or surgical anatomy referred to for further details.

The *Fissure of Rolando* may be found topographically by the following method. The upper extremity of the fissure corresponds to a point

half an inch behind the centre of the line extending from the glabella to the external occipital protuberance.

The direction of the sulcus is downwards and forwards at an angle of about 67° to the middle line. This may be indicated by laying a half sheet of letter paper over the skull the long side corresponding to the middle line and with its centre over the upper limit of the fissure the anterior half is now folded over obliquely from this point leaving an angle of 45° between the front of the paper and the middle line of the skull and then the same process is again repeated bisecting

the angle and leaving one of about 67° , so that the anterior limit of the folded paper corresponds to the line of the fissure which is about $3\frac{1}{2}$ inches in length. A 'Rolandometer,' consisting of two strips of flexible metal united at the appropriate angle, is now sold by many instrument-makers. As a general rule this 'Rolandic line' crosses

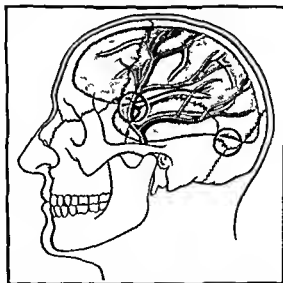


FIG 479 — DIAGRAM SHOWING THE IMPORTANT FISSURES IN THE BRAIN AND THE BRANCHES OF THE MIDDLE MENINGEAL ARTERY

The anterior circle is for exposure of the anterior branch of the artery the posterior one is for exposure of the lateral sinus

the fissure about its centre being in front of the fissure above and a little behind it below but it is sufficiently accurate for practical purposes. The centre of the line between the mid point and the external occipital protuberance marks the position of the parieto-occipital fissure and a line drawn from this point to the external angular process of the frontal bone corresponds in its anterior portion to the horizontal limb of the Sylvian fissure (Fig. 479)

Methods of Opening the Cranium

In the old days but one instrument was employed for this purpose—the trephine—but our increasing knowledge of cerebral lesions and the security given by aseptic methods have necessitated a considerable elaboration in the methods of operating on the cranium.

1. *Simple trephining* is still employed in dealing with lesions where an extensive exposure of the brain is not required. The modern trephine (Fig. 480) is often fitted with a solid metal handle to render sterilization easy and the crown is usually bevelled and not straight so as to check the liability to slip inwards and wound the dura. The scalp is incised and turned aside by raising a flap which has its base downwards so as to ensure its vitality. Bleeding is abundant but is controlled by special scalp forceps which grasp the galea and are turned backwards out of the way.

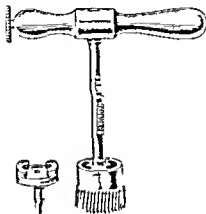


FIG. 480—A MODERN TREPHINE

The pericranium is stripped from the bone and the trephine applied with the centre-pin projecting. As soon as a well marked groove has been made the centre-pin is withdrawn or removed and the instrument carried through the cranium. An increased flow of blood will often indicate when the diploe is reached and care must be taken not to injure the dura. To this end the groove in the bone is carefully examined from time to time by a flattened probe or the blunt end of a needle and the more so when the operation is undertaken in a region where the bone is known to be of irregular thickness or if a venous sinus lies beneath it. The disc is removed by an elevator. Considerable bleeding sometimes takes place from the section of the bone but can usually be controlled by crushing the spot with powerful forceps or by rubbing in Hershey's wax (carbolic acid 1 part oil 2 parts wax 7 parts). If the opening is not sufficiently large it may be increased by skull forceps. The use of the trephine may be avoided by employing an electrically

driven perforator or burr, which penetrates the skull, but does not injure the dura mater

2 In many cases of cerebral abscess the trephine is unnecessary, as the causative focus (*e g* mastoid disease or frontal sinus empyema) is first opened up, and the cranial cavity reached by removing portions

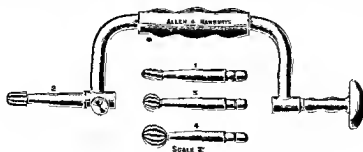


FIG 481—HUDSON'S BRACE WITH CYLINDRO SPHERICAL AND SPHERICAL BURRS

of bone with a gouge. The same thing occurs in many depressed fractures

3 In a decompression operation or for the removal of a cerebral tumour, where a considerable opening has to be made, various plans are adopted

(a) Some surgeons utilize a large 2 inch trephine, but this is obviously undesirable owing to the irregular thickness of the skull, and the difficulty which attends the equal deepening of the groove in all directions over such a large circumference

(b) When it is undesirable to replace the bones a small trephine hole and enlargement by skull forceps should be adopted

(c) Of late, however, some form of Wagner's osteoplastic method (Fig 486) has been chiefly used. In this a large flap of scalp tissues is turned down together with the underlying bone, laying bare the dura mater. Probably the simplest way of dividing the bone is to make

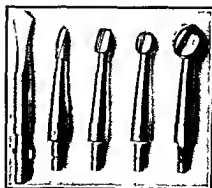


FIG 482—A STARTING BIT AND SERIES OF BURRS FOR TREPHINING THE SKULL

four small burr openings at the corners of the flap with a Hudson's brace (Figs 481 and 482), and connect these by the use of a Gigli saw, *i e* a piano-wire with a screw thread turned on it, and with handles attached at each end, passed by means of a probe under the bone from one opening to another (Figs 483-485); or by the use

of a de Vilbiss rongeur on two sides whilst the upper end is sawn through by a Hey's saw set on the slant so that the incision is bevelled thereby preventing the bone from slipping in when replaced and the base is divided by a Gigli saw or broken across. This procedure is a serious one attended by considerable shock and hæmorrhage and



FIG 483—A MODIFIED GIGLI GUIDE SHOWING THE METHOD IN WHICH THE SAW IS ATTACHED TO IT

therefore may be undertaken as a preliminary measure a week or ten days before the lesion in the brain is attacked.

Cranioplasty—Loss of substance of the cranium arises from many different causes and varies both in extent and effect. Operation may have to be undertaken for one of two reasons either to protect

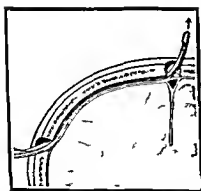


FIG 484 METHOD OF INSERTING A GIGLI SAW BY MEANS OF A GLIDE WHICH ALSO ACTS AS A PROTECTOR



FIG 485

The skull is cut with the saw the underlying dura mater and brain are protected by a metal guide

the patient from the mechanical risks arising from the presence of the defective area or to attempt to remedy the effects of intracranial adhesions etc in the direction of persistent headache epilepsy etc. In the latter case it may be necessary to include the brain itself in the scope of the operation this feature is referred to elsewhere (p 913)

(a) Some degree of protection may be ensured by wearing a metal plate over the cranial defect secured in position over the scalp by elastic straps but this is unsightly and unworthy of modern surgery

(b) A bone graft is used It is desirable in all these cases to detach the dura from the edges of the defect and for a distance of a centimetre or more beyond The operation consists in turning up or down a flap of scalp so as to expose the defect care must be taken in dividing the scar tissue which may be present between the dura and the scalp The dura is then carefully freed from the margins of the opening by a raspator and the closeness of this connection is very marked as soon as the detachment is effected the dura drops back somewhat and the cerebral pulsations become evident

The treatment of the dura and brain is mentioned elsewhere (p 914) Three chief plans of dealing with the opening may be mentioned (a) A flap of pericranium and outer table is fashioned so as accurately to fit over the opening A couple of small drill holes at each end of the defect through the cranial margins and bone flap permits of the introduction of a mattress suture to fix the flap *in situ* The scalp is replaced and secured by sutures without drainage (b) Instead of a bone graft from the neighbourhood one can be obtained quite well



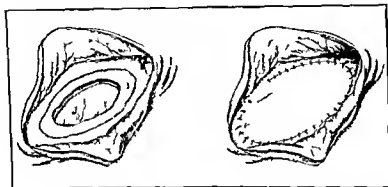
FIG 486—OSTEOPLASTIC METHOD OF OPENING CRANIUM

It will be noticed that the flap of skin and bone is larger above than below thereby facilitating division of the base openings have been made at each corner by a small burr and the base divided the dura mater has been turned down with the bone flap

from the tibial subcutaneous surface or from the outer wall of the ilium including the periosteum (Figs 487 and 488) It is fixed by a large number of small sutures between the pericranium and the periosteum of the flap In either case it is wise to freshen up and bevel the margins of the cranial defect by the use of a burr Excellent results have often followed these proceedings a good solid skull resulting and the headache and pain being completely relieved

(c) A simpler proceeding and one requiring less technical skill, consists in filling up the opening with flaps cut from a costal cartilage The dura mater is freed from the bone as described above The surgeon then exposes the seventh and eighth costal cartilages through a suitable incision and cuts from it a strip of cartilage a little larger than the hole in the skull, sometimes for a large defect two or three

such strips are required they vary in thickness up to one-eighth of an inch. These are slipped into the opening so as to occupy the space between the dura and the bone and are fixed by overlapping the opening on the inner side. The cartilage is believed to remain as such and protects the dura from re-attaching itself to the skull. Admirable results follow, at any rate for a time, the late cerebral symptoms are relieved although there is but little added cranial protection. Celluloid plates have been used in exactly the same manner but the late results are often far from satisfactory and the plates often have to be removed.



FIGS. 487 AND 489.—CRANIOPLASTY BY FIXATION OF A BONY FLAP INCLUDING THE PERIOSTEUM OVER DEFECT IN THE SKULL BY MULTIPLE SUTURES

The Cerebro-Spinal Fluid

Normal cerebro spinal fluid is slightly alkaline and as clear as water with a specific gravity of 1006 to 1008. It contains traces of globulin (not more than 0.02 per cent) and of a copper reducing substance and perhaps a few lymphocytes. It is calculated that from 100 to 130 c c are present in the normal adult but this amount is readily increased if there is a free exit as in some fractures of the base or if the escape is blocked and the fluid is present under tension.

It is mainly derived from the choroid plexuses of the lateral ventricles but receives additions from similar structures in the third and fourth ventricles. It appears to be a true secretion inasmuch as pigments such as bile which stain practically all structures in the body do not pass into it and various drugs such as salvarsan are also held back. The fluid has a definite circulation within the cerebro-spinal space. Starting from the lateral ventricle on either side it passes down through the Y shaped foramen of Monro into the third ventricle and thence by way of the iter into the fourth. Escaping from here through the foramina of Magendie and Luschka it collects in the cisterna magna and thence spreads downwards along and around the spinal cord and forwards along the base of the skull to

occupy the various spaces left between the various elements of the base of the brain. Thence it passes up in the pia arachnoid sheath over the convolutions dipping with the vessels into the sulci and giving sheaths along the various nerves as they emerge from the brain and engage the different foramina. It also communicates with the fluid in the internal ear. Finally it is absorbed into the venous sinuses of the skull through the arachnoid villi (Fig 489) which communicate in large numbers with the interior of the sinuses. Some of the spinal fluid escapes into the lymphatics of the nerve roots (Fig 490). It must be remembered that there are no lymphatics in the brain and that the extensions of the pia arachnoid along the cerebral vessels serve to remove or supply fluid to it and a very efficient mechanism for this purpose it is.

The removal of cerebro spinal fluid has been much employed since Quincke originally recommended it in 1891 and is of the greatest value both diagnostically and therapeutically. Formerly lumbar puncture was the only method adopted but now other situations may be utilized for this purpose.

1 Ventricular Puncture is one for which considerable skill and special knowledge must be available. The main cavity of the lateral ventricle is situated close to the median line and about 4 or 5 cm in front of the upper end of the Rolandic fissure.

The technique of ventriculography consists in making two small incisions in the scalp about one inch on either side of the mid line and about two inches above the lambdoid suture. Local anæsthesia with $\frac{1}{2}$ per cent novocaine is quite sufficient for this operation. The lips of the incision are retracted and small burr holes are made. The dura mater when exposed is carefully nicked with a small crucial incision. The patient is usually placed in a sitting or semi recumbent position and it is important that the head should be securely fixed. A ventricular needle is introduced through the burr hole and passed downwards forwards and inwards in such a way that the lateral ventricle is entered at the junction of the body with the occipital horn (Fig 491). A known quantity of cerebro-spinal fluid is withdrawn and a smaller known quantity of air injected. It is advisable to inject air into one side only as by so doing the potency of the foramen of Monro can be determined by the passage of air from one ventricle to the other. If no fluid can be obtained from one ventricle,

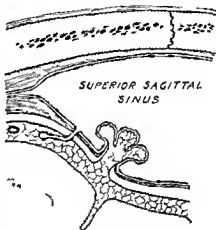


FIG 489—DRAWING SHOWING THE RELATIONS OF THE ARACHNOID VILLI TO THE LONGITUDINAL SINUS

the needle must be inserted into the ventricle on the opposite side. As much cerebro-spinal fluid as possible is withdrawn, and is replaced by a somewhat smaller volume of air, except in cases of marked internal hydrocephalus. The average amount of air to be injected is between 50 and 120 c.c.

When the air has been injected the wounds are closed and the patient is transferred to the X ray department. Lateral and antero posterior skiagrams are taken. The lateral skiagrams (Fig. 492) may show deformity of the anterior or posterior horns by tumours situated in the frontal or occipital regions. The antero-posterior skiagrams

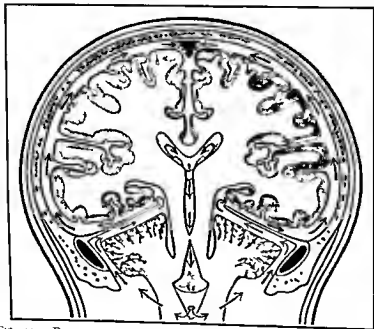


FIG. 490.—DIAGRAM SHOWING THE COURSE OF CEREBRO-SPINAL FLUID FROM THE CHOROID PLEXUSES IN THE LATERAL VENTRICLES TO THE ARACHNOID VILLI IN THE SUPERIOR LONGITUDINAL SULCI.

(Fig. 493) may show a deflection of the ventricles from the mid line or a filling defect of the third ventricle (Fig. 494).

Ventricular estimation is a much simpler and safer procedure than ventriculography and consists of tapping both lateral ventricles and not injecting air. Asymmetry of the lateral ventricles is in itself strong evidence of a cerebral tumour on the side of the smaller ventricle, further a symmetrical hydrocephalus usually indicates a cerebellar tumour.

2 **Cisternal Puncture** (Fig. 495) has already been alluded to in connection with the diagnosis of tumours of the spine and spinal cord.

(p 828) It is also employed for drainage purposes in connection with basal meningitis and may be of assistance when lumbar puncture fails. A similar procedure has been utilized in some cases of meningitis arising in connection with mastoid suppuration a radical operation is undertaken and the meninges opened and it is then possible in some cases to wash the meningeal cavity out from this spot with the assistance of a lumbar puncture and some excellent results have been obtained.

3 **Lumbar Puncture** is the method of withdrawal of cerebro spinal fluid most commonly employed. The technique is quite simple. A stout antitoxin or exploring needle should be selected and sterilized by boiling and the skin in the region of the third and fourth lumbar interspaces (the spinous process of the fourth vertebra is on a line joining the iliac crests) is to be carefully purified. The patient sits or lies with the body well flexed. The needle is then inserted in the fourth interspace either in the middle line or a third of an inch from it. It must be pointed forwards with a very slight inclination upwards. In most cases the needle will go straight into the spinal canal below the termination of the cord and the fluid will escape. If bone is encountered it is advisable to withdraw the needle and reinsert it at a slightly different angle. In cases of repeated failure the third interspace may be tried. Under ordinary circumstances the fluid escapes quietly drop by drop but in cases of increased tension it may gush out freely. The pressure of the fluid can easily be measured by a manometer.

The best manometer is that devised by Greenfield it is convenient and easy to work (Fig 496).

The characters of the cerebro-spinal fluid vary much in different conditions both as to quantity and quality and the study of these is of the greatest help in diagnosis. In *acute meningitis* due to organisms other than the tubercle bacillus the fluid is under pressure and turbid containing much albumen. Many cells are present mainly polymorphonuclear leucocytes and the causative bacteria may be detected by suitable means. In *tuberculous meningitis* the fluid is almost clear and contains a slight excess of albumen and

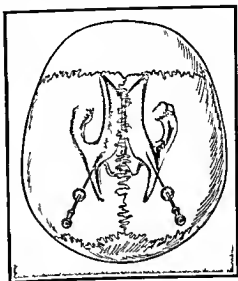


FIG 491—DIAGRAM SHOWING THE VENTRICULAR SYSTEM OF THE BRAIN FROM ABOVE

It shows the position of the ventricular puncture



FIG 491—LATERAL SKIAGRAM SHOWING ENLARGED LATERAL VENTRICLE DUE TO CEREBELLAR TUMOR

in *cerebral tumours*, p 891 in *cerebral abscess* and *lateral sinus thrombosis* the fluid is normal but may be under excessive tension.

The therapeutic value of this procedure has perhaps scarcely been so fully recognized as its use in diagnosis. In many cases of meningitis the coma is due mainly to excessive cerebro-spinal fluid and if the amount of this can be diminished the symptoms often abate. The value of lumbar puncture will therefore depend on whether or not it is possible to influence the intracranial tension thereby and that in turn is dependent on the situation and character of the adhesions present. The puncture must therefore be obviously experimental as one can never be certain as to the adhesions but it is a simple proceeding and may well be employed in all cases of meningitis in the hope that some good may follow. In traumatic conditions it may be useful when the lesion is not very serious, and the pressure on the brain not hopelessly exaggerated. In cerebral

lymphocytes, but tubercle bacilli are rarely found. The fluid is, of course, under pressure and escapes from the needle in a brisk stream. In fractures of the base of the skull or of the spinal cord in injuries to the surface of the brain and in cerebral hemorrhage, blood usually appears around the lower end of the spinal cord within a few hours of the injury, and is intimately mixed with it. For its characters in *spinal cord tumours* see p 825, in *anterior poliomyelitis*, p 530.



FIG 493—ANTERO-POSTERIOR VENTRICULOGAM SHOWING DILATED VENTRICLE DUE TO CEREBELLAR TUMOR

tumours it must be employed with caution as fatal results have followed the removal of a comparatively small amount of fluid owing to undue pressure on the base thereby induced.

It is also possible to introduce drugs within the spinal theca after lumbar puncture *e.g.* *stovain* or *novocaine* for analgesic purposes (see Chapter XLVIII) anti tetanic serum or a solution of magnesium sulphate in tetanus or sodium bromide in delirium tremens. Attempts have also been made to influence by this route para syphilitic nervous affections where the cerebro spinal fluid remains positive to the Wassermann reaction in spite of general medication thus salvarsanized serum or autogenous blood



FIG. 494 — ANTERO POSTERIOR VENTRICULOGRAM SHOWING DISPLACEMENT OF THE VENTRICLES TO THE RIGHT DUE TO A LEFT OCCIPITAL TUMOUR

serum after the use of salvarsan or a solution of corrosive sublimate has been injected after puncturing the meninges but no great success has followed this procedure.

General Conditions of the Brain after Head Injuries

Concussion of the Brain or *stunning* is a clinical condition characterized by a more or less complete suspension of its functions as a result of injury to the head which leads to some commotion of the cerebral substance and may or may not be associated with hæmorrhage. It varies with the severity of the cause from a slight momentary

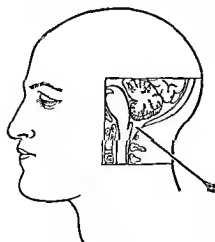


FIG. 495 — DIAGRAM SHOWING NEEDLE IN CISTERNA MAGNA

the patient is at once put to bed with the head low. If conscious he may be given a drink of hot tea but needless stimulation must be avoided for fear of exciting hæmorrhage an enema of hot coffee may be administered or if in *extremis* brandy or a hypodermic injection of strychnine. A good purge such as 5 grains of calomel or a drop or two of croton oil on sugar should be administered after reaction in the milder cases but while still unconscious in the graver forms. It is most important that the patient be kept quietly in bed for at least ten days or a fortnight after a moderately bad concussion and free from all sources of worry and irritation even though he feels quite well. The diet must be restricted and the bowels kept open.

Make haste slowly is here a golden rule.

When the unconsciousness is prolonged, and no signs of fracture of the cranium exist lumbar puncture should be employed and may be most beneficial. Dehydration has become a very useful form of treatment in the last decade intravenous hypertonic saline solution is used in varying strengths up to 25 per cent. or 50 c.c. of 50 per cent. glucose. Should these forms of treatment fail the head should be shaved and an icebag applied the bowels are opened regularly, and the state of the bladder attended to the room must be kept dark and quiet the attendants making as little noise as possible in walking and talking etc. sufficient nourishment must be given either by a spoon if the patient can thus take it or by nutrient enemata or a nasal tube.

Cerebral Irritation.—By cerebral irritation is meant a clinical condition which sometimes follows concussion characterized by great irritability of both mind and body. It usually results from blows or falls on the temple forehead or occiput and is probably due to a superficial laceration of the brain possibly in the frontal region and to the hyperæmia caused by its subsequent repair.

The symptoms are very characteristic and usually manifest themselves two or three days after the injury, though sometimes earlier. The patient lies on his side in a condition of general flexion the back arched the legs drawn up to his abdomen with the knees bent and the hands and arms drawn in. He is restless and may toss about, but never extends himself fully or lies supine. The eyes are closely shut and he resists all attempts to open them the pupils are contracted the temperature is usually a little raised but the surface of the body and head are both cool the pulse is quiet but weak the sphincters are usually in a normal condition and the excreta are often passed in the bed but the bladder may occasionally need to be emptied by catheter. In some mild instances the patient may get up to empty his bladder and then return to bed. He is by no means unconscious but takes no heed of what is passing around and is intensely and morbidly irritable. When disturbed he will gnash his teeth, frown swear and resent the intrusion in the most expressive manner. At the end of a few days or perhaps after a week or two a marked alteration in the condition of the patient usually shows itself. He is less irritable begins to stretch himself out, and with this is conjoined an improvement in both pulse and temperature. Sometimes he becomes

childish, and needs to be taught the names of persons and things, at other times he is garrulous, perhaps giving a fresh story of his accident every day, but generally there is an absolute lapse of memory in this direction. Usually the brain recovers in time, but serious after-effects in the direction of chronic meningitis or mental aberration are likely to ensue.

Treatment—The patient is kept quiet and free from noise and excitement, his diet must be light and nourishing. The head should not be too low, and an icebag may be used if the patient will permit it. The bowels are kept well open, and this is best done by saline purges on account of their dehydrating action which helps to reduce the œdema of the brain. Sedatives such as bromide may be useful. Intravenous hypertonic saline should be tried. When the irritable stage is prolonged subtemporal decompression should be performed. This frequently affords relief to the œdematous brain, with restoration of the normal circulation.

Compression of the Brain—Compression is the term given to a clinical condition due to some abnormal and excessive intracranial pressure which disturbs the functions of the brain. In the earlier stages the blood in the veins and venous sinuses, with the cerebrospinal fluid, are forced out of the cranial cavity, and a position of equilibrium may be reached but as the pressure increases, venous stasis first develops causing cyanosis of the brain with its accompanying irritative symptoms, and later anæmia ensues with its paralytic symptoms.

When of traumatic origin, it may arise from the following causes (a) Depressed bone or the presence of a foreign body in which case the symptoms of concussion merge directly into those of compression, and usually without any interval of consciousness. It is probable however, that in these cases the symptoms are due more to the associated hæmorrhage than to the actual cranial lesion. (b) Extravasation of blood within the cranium, either outside the membranes, or on the surface of the brain, or within its substance. If the bleeding is extradural, there will probably be a short interval of consciousness between the concussion and the compression, if the bleeding is cerebral, the symptoms of compression may manifest themselves at once without any interval being noticed. (c) It may be due to an acute spreading œdema, the explanation of which is subsequently given. (d) It may arise from the pressure of inflammatory exudation or pus in which case the symptoms are preceded by those of inflammation, and at the earliest will not manifest themselves before the third day, but they may be deferred for a week or two.

Compression also arises as a result of idiopathic hæmorrhage, tumours, gummata, or abscesses, *e.g.* of middle ear origin.

The Symptoms of compression are essentially those of coma. When the condition is well established, the patient lies on his back absolutely unconscious, and cannot be roused either by shouting or shaking. His breathing is slow, laboured, and stertorous, the lips and cheeks being puffed in and out. The stertor arises from paralysis of the soft palate and the puffing of the cheeks from paralysis of the facial

muscles. In the later stages the respirations become irregular and take on the Cheyne Stokes type. Gradually breathing becomes more shallow and difficult and death finally arises from cessation of the respiratory act. The pulse is full and slow at first from irritation of the vagus and vasomotor centres but later on becomes rapid and irregular owing to increased pressure upon and exhaustion of these medullary centres. The surface of the body may either be cool hot or perspiring the temperature similarly varies often being low in the early stages and higher at a later date. Not unfrequently the fatal end is associated with marked hyperpyrexia. In some cases where the compressing force is unilateral there may be some difference of temperature on the two sides of the body. The pupils vary according to the degree of compression and the situation of the compressing agent. If the cerebral pressure is equally diffused both pupils first contract and then gradually dilate and become reactionless but if one hemisphere is affected more than the other the pupil on that side passes rapidly through these changes whilst on the opposite side they are not developed until later. Thus it is a common thing to find the pupils unequal in size and reacting differently to light. The whole body in the later stages is in a condition of *motor paralysis* but at an earlier period of the case there may be some difference on the two sides if the lesion is unilateral thus if the left side of the brain is primarily affected a right-sided hemiplegia is likely to be present at a time when the muscles on the left side can still respond to cerebral stimuli. A localized compression involving the motor area may lead to convulsions in the corresponding group of muscles. The voluntary control over the bladder is lost and hence retention ensues the sphincter ani is often relaxed and faeces pass involuntarily although marked constipation is usually present.

The symptoms in some cases are ushered in by severe pain or head ache which is partly due to pressure upon and tearing of the dura mater and partly to the altered vascular conditions of the brain the brain substance itself is not sensitive and hence the pain is not directly referable to any lesion of or pressure upon it. Naturally the clinical picture is modified according to the cause of the compression even as the course of the case varies widely according to whether or not the compressing agent can be removed by the surgeon or absorbed by natural processes.

The **Diagnosis** of coma from compression when a complete history of the case can be obtained is often easy and, indeed the whole clinical aspect may be so typical that no question as to the cause of unconsciousness can be raised. But when a person is found in the streets unconscious and no history either of the patient or of an accident is obtainable and no serious lesion of the skull is present the diagnosis is often extremely obscure since coma may be due to many other causes e.g. (a) Cerebral lesions such as apoplexy whether the result of hemorrhage embolus or thrombosis or it may be the consequence of a preceding epileptic fit or due to a rapidly spreading oedema in cases of cerebral tumour or abscess. (b) Various toxic agents may induce coma they may be introduced into the

system from without, as in the case of alcohol, opium, or other narcotics, or may be developed within the body as in uræmia or diabetic coma. (c) Heatstroke or exposure to cold may also lead to unconsciousness. In the latter case there can be but little doubt as to the cause, since the patient is cold, pale, and in a state of severe prostration, in the former the diagnosis may for a time be doubtful. (d) Lastly, it must not be forgotten that two or more of these conditions may co-exist. Thus a drunken man may fall and break his skull, and then the smell of liquor in his breath may lead to an erroneous diagnosis.

It is therefore evident that a very thorough examination is required before any conclusion can be arrived at as to the cause of the coma, and it is often impossible to make an immediate diagnosis. In such cases the patient should be carefully tended and watched, and not shut up in a police-cell without attendance.

The following points should always be observed in the examination. (1) A rapid note should be made as to the surroundings of the patient—whether there is blood or vomit near him, how the body is lying, and the nature of the ground. (2) The depth of the coma should be tested, and, if possible, the man should be roused, and asked to give an account of himself. (3) A most thorough and complete investigation should be made as to his condition. The skull is first examined, to settle if possible whether a fracture is present, the surface temperature is noted, as also the character of the pulse and respirations. The tongue should be looked at, as it is often bitten in an epileptic fit. The smell of alcohol in the breath is not sufficient warrant in itself to diagnose merely drunkenness, as the alcohol may have been given after the accident. The condition of the pupils may throw some light on the case: in opium poisoning they are small and equal, a condition also seen in hæmorrhage into the pons, in alcoholism they are often dilated and fixed, but vary considerably. The amount of power and the state of the reflexes are then observed, any inequality probably indicating a unilateral lesion in the brain. The urine must be drawn off, and examined for albumen and sugar. (4) In dubious cases, and especially where there is any suspicion of drunkenness or poison, the stomach should be washed out. (5) Finally, if the cause is still uncertain, the patient should be put to bed and carefully watched.

The Treatment of compression must be, where possible, directed to removing the cause. When it is due to depressed bone or a foreign body, immediate operation is required, collections of pus should be opened, and blood-clots removed. Failing such measures, and if lumbar puncture gives no relief, the treatment of the condition resolves itself into keeping the patient quiet, with the head low and cool, the room dark and noiseless, the bowels open (using croton oil or sugar, or enemata, for this purpose), and the bladder empty. The patient may be fed by rectum, and if the breathing or pulse is very laboured, and cyanosis begins to show itself, venesection may be advisable. Considerable interference with the respiration arises from falling back of the tongue, as often occurs in profound anæsthesia during operation,

and if due to this cause the head may be rolled over to one side or the tongue pulled forwards.

Laceration of the Brain.—Injuries to the brain and its membranes are frequent complications of head injuries and all the most serious results of these accidents arise from this source. They are produced in many different ways and cause varied symptoms but the most important distinction to draw is between those wounds which communicate with the exterior and those which do not.

I Non penetrating Wounds of the Brain result from blows and falls which may or may not produce simple fissured or depressed fractures of the skull but not unfrequently the most serious cerebral symptoms follow injuries in which the bones do not participate. In depressed fractures the brain is usually most contused or torn immediately below the injured spot but in cases where there is no depression the greatest mischief is frequently found at a point exactly opposite to that struck (point of *contrecoup*) whilst the local bruise may be much slighter. Thus in the case of one of our students who in an epileptic fit fell striking the left occipital region on a stone pavement we found *post-mortem* a fissured fracture at the spot struck and a bruise on the left occipital convolution whilst the anterior portion of the right frontal lobe was severely contused and indeed disintegrated. The explanation of this fact is that the force of the injury is transmitted to the brain substance as a wave which concentrates its violence against the opposite side of the skull. In very sharp sudden localized blows as from a spent bullet local bruising of the subjacent brain may be alone produced.

Pathological Anatomy.—The immediate effects of such an injury vary considerably. There may be a mere bruise evidenced by a few points of extravasation on the surface or in the grey matter or the more superficial parts of the brain may be totally disintegrated and mixed with clots or if laceration has occurred clots may be found adhering to the injured spot or extending from it widely into the subarachnoid space or even under rare circumstances into the lateral ventricle. The later effects in cases where the wound does not communicate with the exterior are mainly those of inflammation or degeneration. Soon after the accident considerable exudation follows causing the ecchymosed brain substance to swell and become oedematous this may speedily subside but in the more serious cases a *spreading oedema* may be caused owing to the pressure of the swollen tissues upon the superficial veins in the pia mater the circulation in these is hindered and increased exudation follows leading to general cerebral pressure and even death a consequence hastened by the excess of cerebro-spinal fluid usually induced by the process. Under such circumstances the greater part of the brain is oedematous and glistening the injured area being yellowish red in colour with evident points of extravasation scattered through it. Still later degeneration of the brain substance may follow owing to the disturbance of its circulation and is indicated by the presence of a pulpy yellowish mass soft enough to be washed away by a stream of water and containing fat globules and granular cells with debris of nerve fibres (yellow

softening) If the area involved is small and unimportant, the patient may recover, the softened tissue being absorbed and replaced by a scar, if large or implicating important centres death or paralysis must ensue. In cases of laceration of the brain which recover, a tough depressed cicatrix is formed, usually adherent to the membranes and containing hæmatoidin crystals, whilst extravasated blood may be organized into a dirty brownish lamina, adherent to the pia mater, or into an arachnoid cyst.

Clinical History.—The symptoms necessarily differ with the severity and locality of the lesion.

Whenever concussion occurs after a head injury, and the patient recovers slowly from it, the surgeon will rightly suspect contusion or laceration of the brain. In the slighter cases recovery is often inaugurated by an attack of vomiting and this is followed by a rise of temperature to about 100° F for a few days, whilst the patient complains of fixed pain and headache which under suitable treatment may entirely disappear. Some impairment of sense or of function, however may persist.

More serious lesions give rise to various symptoms resulting from hæmorrhagic effusion and these develop either at once or within twenty four or forty eight hours of the injury. Thus if the phenomena of compression supervene at once without any interval of consciousness a diagnosis of depressed bone or a serious hæmorrhage into the cerebral substance may be safely made. If, on the other hand the patient rallies for a time before becoming comatose an extradural hæmorrhage from the meningeal vessels or venous sinuses may be suspected. Moreover the possibility of a rapidly spreading œdema ought not to be forgotten.

Hæmorrhage into the cortex is characterized by irritative or paralytic phenomena which vary with the cortical area involved. The degree of unconsciousness depends on the amount of the hæmorrhagic effusion.

In the *Upper and Middle Frontal Convolution* neither motor nor sensory symptoms are noted but cerebral irritation and subsequent weak mindedness are likely to follow especially if the left side is involved. Lesions to the right frontal lobe do but little harm to a right handed individual. Apparently the intellectual faculties as well as speech are limited to one side of the brain.

Wounds of the *Third Left Frontal Convolution* lead to motor aphasia, i.e. the inability to produce or articulate words, in right-handed individuals in left handed people wounds of the right side have a similar result. Injury to the opposite convolution has no effect. If only one side is damaged the other can sometimes be educated so as to take on its function.

Hæmorrhage into the *Motor Area* results in localized convulsions or paralysis according to the degree of mischief. If the bleeding is progressive a regular extension of the convulsions may be witnessed the movements commencing perhaps, in some region which is at the same time incapable of voluntary movement and spreading to other parts of the body. Thus, if bleeding is occurring into the

cortical centres for the face on the left side of the brain paralysis of the right side of the face may be present and it is here that the convulsions will start spreading regularly to the right side of the neck arm and leg and then involving the left leg arm and side of the head in order finally becoming general as in an epileptic fit After each convulsion the paralysis is found to have spread

It is sometimes very difficult to diagnose between a true cortical hæmorrhage and one which extends diffusely over the cortex in the subarachnoid space from the rupture of a vein in the pia mater In

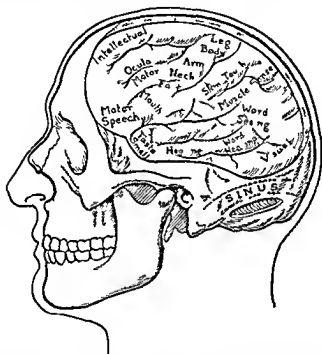


FIG 497.—DIAGRAM REPRESENTING THE FUNCTIONS OF THE CEREBRAL CORTEX
The outline of the ventricular system is shown in its relation to the skull

the latter however the symptoms develop earlier the paralysis is less marked and the convulsions are less regular though perhaps more generalized

An irritative lesion of the motor area for the head and eyes causes a conjugate deviation of the eyes towards the other side a destructive lesion causes both eyes to be deflected towards the injured side The posterior wall of the fissure of Rolando is concerned with cutaneous muscle and joint sensibility

Wounds of one *Occipital Lobe* may cause a temporary homonymous

hemipopia, but no persistent loss of vision unless the angular gyrus is also destroyed. Lesions of the latter region are always associated with permanent disturbances of vision (Fig 497).

The *Upper Temporo-sphenoidal Lobe* contains the cortical auditory centre, and lesions in this region cause deafness. The sense of smell is located in the anterior portion of the lower temporo-sphenoidal lobe which constitutes the uncinate process.

Injury to the *Corona Radiata* leads to paralysis of the regions represented by the overlying cortex, but without convulsions or other irritative phenomena. If the corpus striatum or internal capsule is torn or involved in a hæmorrhage, coma rapidly supervenes, accompanied by hemiplegia and perhaps hemianæsthesia. Occasionally the effused blood bursts into the lateral ventricle, and causes a rapid rise of temperature, increasing until the patient's death, together with a very rapid weak pulse and increased respiratory rate (40 to 60 per minute).

Wounds of the *Cerebellum* cause giddiness, vertigo, ataxy and nystagmus, the patient reeling about in characteristic cases, as if drunk, and if the lesion is unilateral falls to the side of the injury.

A wound of the *Crus Cerebri* occasions more or less complete hemiplegia of the opposite side of the body, associated with some amount of hemianæsthesia, and total paralysis of the 3rd (oculo-motor) nerve on the side of the injury.

Laceration or contusion of the *Pons Varoli*, if not immediately fatal, may lead to paralysis of the opposite side of the body, together with paralysis of the 5th, 6th, 7th, or 9th nerves, on the same side as the lesion constituting the so called 'crossed paralysis'. Marked contraction of the pupils (myosis) may also be present.

Wounds of the *Medulla* are usually fatal. If, however, the patient should escape, he is liable to suffer from disturbed functions of the circulatory and respiratory centres, with perhaps Cheyne-Stokes respiration and glycosuria.

Pyramidal Signs—Motor impulses are conducted from the cortical motor areas to the muscles chiefly by the pyramidal tract. From the motor cells in the cortex the fibres converge through the corona radiata into the internal capsule, thence after passing through the pons and medulla cross to the other side of the body and terminate in the anterior horn cells. Lesions of the cerebral portion of this tract produce a certain degree of hemiplegia, varying from slight paresis to complete paralysis. At the commencement there is usually flaccidity of the affected side, which in a week or ten days is succeeded by hypertonicity with a tendency to flexion of the upper limb and to extension of the lower. Clawing of the hand, which gives the sensation of elastic resistance, becomes progressive from the onset of the hypertonicity. The platysma may be observed to contract more energetically on the sound than on the paralyzed side, and the tongue deviates slightly to the side of the paralysis. The deep reflexes are usually more active on the paralyzed side. The alterations in the cutaneous reflexes are particularly significant. The plantar reflex gives an extensor response (Babinski sign), and the abdominal reflexes

on the paralyzed side may be either diminished or absent. Other signs of less importance may be found in textbooks dealing with the subject.

The later results of a cerebral laceration vary much. The patient may recover perfectly after a more or less prolonged period of unconsciousness, but not unfrequently some loss of power persists which will seriously impair the patient's subsequent usefulness.

The febrile phenomena already mentioned as characteristic of the first few days of convalescence after an attack of concussion may pass into a condition of subacute or chronic localized inflammation of the injured area, as indicated by pain and headache. In such cases the inflammatory effusion may be so abundant as to determine the onset of unconsciousness in four or five days. Occasionally an abscess forms deeply in the white substance and this will be indicated by the usual phenomena of such a condition coming on ten or fourteen days after the injury.

The formation of cicatrices between the brain and membranes may determine the development of traumatic epilepsy or insanity at a later period (p. 913).

The Treatment of these cases is always an exceedingly anxious matter for the surgeon. In the majority of instances it is merely symptomatic, following the usual course adopted in concussion, compression, cerebral irritation, etc., as indicated elsewhere. Depressed bone, if present, will of course be dealt with by operation. Early convulsions and paralysis are carefully watched to see if any indication as to the site of the bleeding can be obtained, since it is possible that trephining over the injured spot and removing blood-clots or securing bleeding points might be advisable, but the clinical records of such treatment are not very encouraging. Late convulsions and paralysis due to inflammation are best treated by shaving the head and applying an ice-cap and by lumbar puncture. If the pulse is full and hard and the patient otherwise young and healthy, general venesection may be adopted, the bowels must be moved by a smart purgative such as croton oil, whilst bromide in full doses may be administered. If the convulsions continue in spite of such treatment and become more severe and extensive, the patient will almost certainly die of coma, trephining over the injured area is then distinctly indicated, the surgeon hoping to find and remove some clot or, at any rate, to relieve tension by decompression, care being taken in all cases where the intracranial pressure is high to reduce this before opening the dura mater by tapping the ventricle.

In quite a number of these cases a subtemporal decompression is indicated. The patient has recovered from his concussion but remains in an irritable, semi-conscious condition, noisy and restless at times and at other times more or less comatose, his mental condition is bad and the bodily functions irregular. Lumbar puncture is sometimes useful, but the patient is so restless that it is dangerous to do it apart from a general anæsthetic and repeated administrations are undesirable. When no localizing symptoms are present (and this is often the case) the skull may be advantageously opened beneath

the temporal muscle, which is turned down for the purpose, a free removal of bone follows, extending antero-posteriorly rather than transversely, and the dura mater is opened. In this type of case the brain pulsations cannot usually be felt before incising the dura, a free flow of cerebro spinal fluid follows the incision in most cases, and the brain pulsations are then at once re established. The dura is turned back in flaps and stitched aside, and the temporal muscle laid down again in place and fixed by sutures. The skin incision is closed without drainage. The effect of this procedure is to provide a permanent relief of tension to the intracranial space in a comparatively safe position. In some cases of this type definite fulness in the temporal fossa is noticed for a time. The patient in favourable cases loses his headache, and becomes quiet and rational in a short time. In one instance the patient expressed himself as more capable of mental concentration after this operation than he ever had been before his accident (air crash).

It may, however, be desirable in supposed cases of cerebral cedema to employ the intravenous injection of a hypertonic saline solution prior to operation. The cerebral tissue is one of the most sponge like structures in the body, readily absorbing and quickly giving up fluid to the pia arachnoid prolongations which accompany the vessels in their distribution. The call to dilute the hypertonic solution injected into the blood stream will first be answered by the loose fluid contained in the cerebral substance, and may remedy the coma induced thereby.

II Penetrating Wounds of the Brain result from blows or falls, as in compound depressed fractures, or from the entrance of foreign bodies, such as bullets, shrapnel or shell fragments, or from stabs or punctures, which most commonly occur in the weaker parts of the cranium, e.g. the temple or upper wall of the orbit, or from sabre-cuts or axe wounds in which an oblique or almost valvular incision is made through the scalp and cranium, laying bare and wounding the brain and its membranes.

In some cases where the skull has sustained a considerable degree of injury, and a large opening results, the general disturbance is often slight, compared with the extent of the local injury, so that, although brain substance may protrude from the wound, there is sometimes but little concussion. The chief dangers arise when the opening is but small. Any of the conditions due to hæmorrhage detailed below may follow, but they may be slight if the blood can escape from the wound. The inflammatory phenomena due to infection of the wound may be localized or diffuse. In the latter instance general meningo encephalitis manifests itself in the course of two or three days, and is rapidly fatal, in the former case adhesions prevent the extension of the trouble beyond the neighbourhood of the wound. *Hernia cerebri* is very likely to follow, and possibly a deep cerebral abscess may complicate matters at a later date. In cases that have been successfully rendered *aseptic*, the course is similar to that run by a non penetrating wound, except that, if anything, the immediate prognosis is better, since the opening in the skull diminishes the likelihood of compression from simple or spreading

cedema Where the lesion has involved the motor area permanent monoplegia may persist and later symptoms are always liable to arise owing to the formation of cortical adhesions

Treatment—In all cases of punctured or compound depressed fracture a thorough exploration of the wound should be made and all depressed or injured bone removed Foreign bodies should be taken away if found close to the wound and often the mere removal of a superficial blood-clot from the mouth of the track will permit the brain to vomit out deeper clots and even fragments of bone or small foreign bodies The method of sucking up broken down and disintegrated brain tissue by a catheter and ball syringe has already been alluded to (p 852) Bullets or large shell fragments or foreign bodies ought to be removed if within 2 inches of the surface (P Sargent) but if deeper they should be left alone unless there is a definite and easily followed track leading to them Protruding brain tissue is washed with hot normal saline solution and left *in situ* Bleeding points in the brain are controlled by pressure over small flaps of muscle or fascia but the application of a swab wrung out of hot saline solution should be first tried The dura mater should if possible be drawn together by one or two sutures and the scalp-wound is closed if possible completely so as to avoid the use of drainage on account of the risk of infection entering through the drain opening if employed the gauze or tube should be removed when all is going well in about two days time If the temperature rises as a result of infection the wound must be reopened and every effort made to relieve tension and thus localize the mischief Lumbar puncture should be frequently undertaken and the fluid examined for organisms an autogenous vaccine has been found useful in some cases Should diffusion occur as indicated by an increasing severity of the symptoms the patient must be treated in accordance with the general principles laid down for dealing with acute meningitis

It is imperative that from the earliest possible moment the patient should be placed under the influence of bromides in order to quiet him and protect him from the risks of epilepsy

In this description of lacerations of the brain the fact that symptoms may arise from inflammatory conditions affecting the bones (p 839) has been purposely omitted In actual practice the course of events is often considerably modified by such complications

Later Management of Head Cases—All injuries involving the skull and associated with cerebral symptom must be regarded as of a serious nature and the patients before being discharged from medical supervision should be warned as to the course of life that is desirable and the restrictions that should be observed these naturally are more urgent in the more serious cases Thus after a penetrating lesion of the brain such as occurs in gunshot wounds and in particular if there is a marked cranial defect or if the patient has recovered from a hernia cerebri he should be advised to live as quiet and regular a life as possible the country is to be preferred so as to avoid the hurry and bustle of town life alcohol is absolutely forbidden sexual excitement must be avoided the diet should be simple and unstimulating

the bowels must be kept regularly open. Light work may perhaps be undertaken which does not involve hanging the head downwards, or overstrain mental or physical. Fatigue and exhaustion are to be avoided, and the patient must indulge in plenty of sleep. Hot and badly ventilated rooms are undesirable and places of public recreation are best avoided. Cinema shows are extremely bad, the vibratory movements of the pictures disturbing the patient's sense of equilibrium. The head should be well protected in hot weather and these patients should not be sent abroad to hot climates. In fact the patient after a bad head injury must develop a 'vegetable' type of life for a while and nothing can be much better than light work on a farm for a year or two. Gradually as the brain recovers tone, the ordinary stress and strain of life may once again be taken up.

In spite of such care, or more frequently owing to the want of it, many patients who have sustained penetrating wounds of the brain from which they have recovered as a result of an effective decompression begin to experience after a while symptoms, partly due to the injury, partly to the after results of the operative treatment. They complain of headache more or less constantly varying in degree with the amount of excitement and noise around them, they also suffer from anorexia and constipation and perhaps from vomiting. They are unable to concentrate their attention on reading or games, and become morose and irritable. Possibly epilepsy supervenes and if the motor area is involved this may be of the Jacksonian type. Vision is often defective owing to paresis of accommodation, and they may complain of giddiness and noises in the head. Some of these symptoms are undoubtedly functional but others are very genuine results of the local lesion. Occasional exacerbations occur if the patient is exposed to cold and fatigue he may even become unconscious and die.

The head wound is usually found to be tense, and no cerebral pulsations can be felt. The opening in the skull is closed by a firm scar which is attached to the margins of the cranial defect. It may even bulge outwardly during the more severe attacks.

These cases may be improved by keeping the patient quiet and giving him bromides, attention to the bowels is also desirable. Few of them will improve permanently unless the dura is freed from the cranial attachments and some form of cranioplasty is almost always necessary. If no operation has been undertaken at the time of the injury a number of these cases are greatly improved by subtemporal decompression.

Injuries to the Intracranial Blood-vessels.

1. **Wounds of the Venous Sinuses** are by no means uncommon, being torn across in fractures, or punctured either by some sharp instrument or by spicules of bone. The superior longitudinal petrosal, lateral, and cavernous sinuses are those most frequently involved, especially the first, because it is more intimately connected with the bones than any of the others. Not unfrequently a depressed fragment of bone

is driven into a sinus and no bleeding occurs until the fragment is displaced with a view to elevating it when a serious gush of dark venous blood will follow. When there is no external wound and the outer wall of the sinus has been torn the hæmorrhage may strip up the dura mater and compress the brain producing effects resembling those due to a wound of a meningeal artery but generally the bleeding is not great since comparatively little pressure suffices to arrest it by determining thrombosis. If however the inner wall of the sinus is torn across the blood finds its way between the meninges and gives rise to the symptoms of diffuse intracranial hæmorrhage. When an external wound exists there is the usual evidence of venous bleeding but it is readily checked and rarely fatal. Infective thrombosis and pyæmia are the chief dangers but entrance of air has also led to a fatal issue in a few cases. Treatment, when practicable consists in plugging the sinus with aseptic gauze and applying an antiseptic compress possibly removing fragments of bone in order to expose it. Where the outer wall alone has been torn it may be possible to suture it without interfering with its continuity but failing this a flap of fascia should be cut and applied to its outer surface in a minute or two gentle pressure has caused it to adhere like a postage-stamp and the bleeding ceases. For symptoms and treatment of infective thrombosis see p. 886.

2 Wounds of the Middle Meningeal Artery—This vessel enters the skull at the foramen spinosum and subsequently divides into two branches which ramify between the skull and the dura mater. The anterior branch is most frequently torn as it crosses the antero-inferior angle of the parietal bone as the result of any type of fracture in that locality. The artery is however sometimes ruptured by a blow on the side of the head sufficiently severe to detach the dura mater but without causing any injury to the bone this membrane always carries the vessel with it and if it emerges from a bony canal just at that spot as so often happens the artery is torn across by the projecting inner lip of the canal. Whether or not the dura is primarily detached the blood soon collects between it and the bone pressing the brain inwards and burrowing down towards the base of the skull (Fig. 498). This is due mainly to the force-pump-like action of the arterial pressure for when fluid is driven into a closed cavity the power of the jet is multiplied by the area occupied. The clot rarely measures more than 4 inches in diameter. The posterior division is only wounded in about 5 to 10 per cent. of the cases.

The Symptoms are unfortunately often obscured by some co-existent cerebral lesion or complication but in a typical case three stages should be present:—(a) A primary concussion as the result of the blow (b) a temporary return to consciousness the so-called lucid interval and (c) cerebral compression causing a gradual supervention of coma within twenty-four hours and that usually without any considerable rise of temperature though it may be associated with severe pain in the head and vomiting. The interval of consciousness varies widely but it is not often longer than an hour or two whilst in many cases it is scarcely recognizable. On the other

hand cases are known where symptoms were delayed for days or even weeks after an injury. As accessory signs the following may be mentioned (1) Since the blood clot is situated close to the motor area of the cortex and especially over the centres of the head and arm twitching of these parts followed perhaps by flaccidity and paralysis may be a well marked feature and usually supervenes before the onset of coma. (2) When the clot extends to the base of the skull it presses on the cavernous sinus and may induce passive congestion of the eyeball paresis of some of the ocular muscles and proptosis. (3) The pupils may often give valuable information. That on the injured side will be contracted at first owing to the irritation of the third nerve as the pressure rises the third nerve becomes paralyzed and dilatation of the pupil takes place owing to the unrestrained action of the cervical sympathetic. If the pressure is maintained its effect is transmitted across the mid line with the result that the third nerve is irritated and contraction of the opposite pupil ensues. This in turn will be followed by dilatation of the pupil as the third nerve becomes paralyzed. If operation is not performed to relieve the condition death ensues both pupils being dilated and fixed owing to the fact that both the third nerves are paralyzed. The Prognosis is extremely unfavourable.

The Diagnosis of extradural as distinct from intradural hæmorrhage is by no means simple. The latter is usually more rapid in its onset and if involving the motor area may be associated with definite cortical phenomena. It is likely to be associated with blood staining of the cerebrospinal fluid unfortunately the two conditions not unfrequently co exist.

The Treatment consists in opening the skull in order to remove the blood-clot and secure the artery if still bleeding. The spot selected for dealing with the anterior division of the artery is $1\frac{1}{2}$ inches behind the external angular process of the frontal bone and $1\frac{1}{2}$ inches above the zygoma. The scalp is shaved and thoroughly purified and a vertical incision is made which includes everything as far as the pericranium (Fig 499). A crucial incision is then made over the selected spot and the pericranium reflected sufficiently to allow

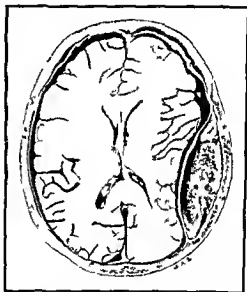


FIG 498.—MENINGEAL HÆMORRHAGE (FROM SPECIMEN IN COLLEGE OF SURGEONS MUSEUM)

a 1 inch trephine to be applied (Fig 500) On removing the disc of bone a mass of blood-clot presents, which should be broken up with the finger and washed or scraped away If the artery is seen bleeding on the dura mater, it may be possible to pick it up, and tie or twist it, or a fine curved needle threaded with catgut may be passed under it and thus a ligature applied If, however, the blood comes from a canal in the bone, the outer table must be clipped away sufficiently to enable the canal to be seen and plugged by a small piece of aseptic wax, sponge, or gauze, which may be left without danger The incision is then closed, drainage is not usually necessary and should be avoided owing to the risk of infection

Should the meningeal vessels be intact the opposite side should be explored When there is bleeding under the dura, there is no pulsation of the dura at that point Sometimes there is a bluish discoloration A small incision in the dura clinches the diagnosis for if blood is present it spurts out, and with it bits of clot

The posterior branch of the artery can be reached by trephining



FIG 499—INCISION FOR EXPOS-
ING THE MIDDLE MENINGEAL
ARTERY



FIG 500—THE AREA OF BONE
REMOVED IN CASES OF MIDDLE
MENINGEAL HEMORRHAGE

immediately below the parietal eminence at the same level as for the anterior branch

3 **Wounds of the Internal Carotid Artery**, in its intracranial portion, are rare but if complete are necessarily fatal They usually result from penetrating wounds of the orbit, or from a gunshot wound or the vessel may be torn by a splinter of bone in a fracture of the base of the skull Mere fissures through the carotid canal do little harm since there is plenty of room within it around the artery Occasionally however, the artery is slightly torn, and an aneurismal varix develops between it and the cavernous sinus Treatment—The injury is fatal in the majority of cases before help can be obtained if not, compression of the carotid trunk or ligature of the internal carotid in the neck is the only hope See also on orbital aneurism (p 346)

4 **Intracranial Hemorrhage** arises from wounds of the cerebral cortex or membranes in cases of fractured skull, or from concussion without fracture The blood may be derived from the veins and capillaries so abundantly present in the pia mater, or from lesions of the inner wall of venous sinuses, or even from the middle meningeal

artery, if the dura mater is also opened. It may be widely diffused over the surface of the hemispheres or may be more localized. It is often but slowly absorbed, and may become encapsuled, constituting what is known as an *arachnoid cyst*, i.e. a closed cavity containing serum, the walls of which are formed of fibrous tissue stained brown with hæmatin.

The **Symptoms** are those of concussion or compression and need not be discussed further.

The **Treatment** is symptomatic, the patient being kept absolutely quiet, and all excitement and noise which might induce cerebral congestion excluded. If there be any focal symptoms, an exploration should be undertaken with a wide osteoplastic flap. The hæmatoma is evacuated after carefully opening the bulging dura, rarely is a bleeding vessel seen, but if one should be present it can be readily stopped by holding a small piece of muscle on it. No drainage should be employed. If there is no hæmatoma present, the base of the osteoplastic flap can be removed, allowing decompression to take place.

5 **Cerebral Hæmorrhage** occurs more frequently from idiopathic causes than from trauma, except in the case of severe lacerations. In the more aggravated forms death is practically certain to result in a short time from increased intracranial tension.

Intracranial Inflammation.

Inflammation of the cranial contents is almost always bacterial in origin, and may follow a great variety of lesions, e.g. (1) Injuries of all types, but especially compound or punctured fractures. (2) Middle-ear disease is perhaps the most frequent origin of these affections, the infection reaching the brain through an opening in the tegmen tympani or spreading from the mastoid process along the sigmoid groove in which lies the lateral sinus. (3) It may extend inwards from scalp, face, nose, or neck by ways of the emissary veins, or even along the sheaths of nerves. (4) It may accompany simple contusion of the cranial bones (p. 841) as a result of an auto-infective inflammation in these structures. (5) It may develop as a complication of pyæmia, septicæmia, pneumonia, scarlet fever, small-pox, and other general infective diseases. The causative bacteria in the preceding groups are generally staphylococci or streptococci, when the inflammation is due to traumatism, but the pneumococcus is usually present, when the mischief extends from the middle ear or accessory nasal sinuses. (6) It may constitute the chief manifestation of a general infective fever, spreading from the nasal fossæ, and known as *Cerebro spinal Fever*. This affection is due to a specific organism, the *Diplococcus intracellularis* or *Meningococcus*, and is extremely infectious. Certain individuals have been proved to be 'carriers' of this organism in their nasal fossæ, and infection may be spread by them by coughing and sneezing. Medical textbooks must be consulted for a description of this disease. (7) Chronic inflammatory trouble may arise from tubercle and syphilis.

It must be remembered that in actual practice the different forms

of inflammation described below run into one another and that the resulting symptoms are often a complex mixture of several types. For descriptive purposes the following groups may be differentiated.

(1) **Subcranial Inflammation (Pachymeningitis)** manifests itself either as a simple thickening of the dura or as an effusion of pus between the dura and the bone (subcranial abscess).

Simple Pachymeningitis results either from a slight simple depressed fracture or from a contusion with or without a fissured fracture or from the gradual spread of a mild infective inflammation from the overlying bone. The process is really protective in character the dura becoming thickened. It may extend to the under surface of the dura and lead to a localized lepto-meningitis characterized by adhesions between the cortex and the dura. If the process extends no further the clinical manifestations are slight consisting merely of pain and localized headache. For treatment see chronic meningitis (p. 886).

Subcranial (or Extradural) Abscess results from either a compound depressed or a punctured fracture in which the dura mater is only separated from the bone and not lacerated especially when the external wound is small and efficient drainage is not obtained. It also occurs by auto-infection in consequence of a simple contusion or fracture of the skull leading to a detachment of the membranes and a collection of blood in the cavity thus produced. Any form of osteomyelitis of the cranial bones may determine its onset as also the lodgment of a pyæmic embolus but apart from injury its most common cause is without doubt extension of inflammation from the middle ear.

A perforation of the tegmen tympani (Fig. 503 B) allows of the invasion of the cranial cavity and an abscess forms above the attic which perhaps discharges through the ear in other cases the supuration extends along the groove for the lateral sinus. In the former instance a localized subdural abscess may subsequently develop limited by meningeal adhesions and the intervening dura mater may slough in the latter thrombosis of the lateral sinus may follow.

The Symptoms produced are (1) those generally characteristic of suppuration in a high temperature with perhaps rigors. (2) The signs of intracranial pressure in the form of fixed headache followed by coma are also present if the abscess is large or if it affects the cerebral membranes sufficiently to cause a serous meningeal effusion. (3) If there is no open wound an oedematous swelling of the scalp known as *Pott's puffy tumour* may develop over the site of the abscess (Fig. 501). When there is a compound fracture of the skull the margins of the wound look unhealthy and at its base may be seen bare bone yellow and dry from which the pericranium has separated perhaps with pus oozing out between the fragments. If the pus burrows towards the base of the skull optic neuritis may develop. (4) Focal symptoms of spasm or paralysis may complicate the case if the dura over the motor area is involved. The Treatment of such a condition consists in evacuating the abscess cavity through a sufficient opening made by trephining or by removing loose or diseased portions

of bone and providing for drainage. Sometimes more than one opening is required for this purpose.

When the affection follows otorrhœa the mastoid antrum is usually opened up, as also the attic and sufficient bone gouged or cut away from the roof to give effective drainage.

Occasionally the condition is of a diffuse subacute character, spreading widely over the surface of the dura mater and causing extensive mischief. In one case observed it followed a carbuncle on the back of the neck and in another it was due to syphilitic disease of the cranial bones with septic complications. Pus spreads along the dura, the outer surface of which is thickened by granulation tissue, and the membrane itself becoming gradually softened allows the surface of the brain to become involved. The bones become carious with a certain amount of necrosis of the inner table. Pus finds its way

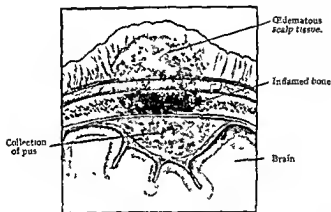


FIG 501.—SUBCRANIAL SUPPURATION INVOLVING OVERLYING BONE AND CAUSING AN EDEMATOUS CONDITION OF THE SCALP—POTT'S PUFFY SWELLING (SEMI DIAGRAMMATIC)

to the surface through the bone possibly through the foramina for emissary veins and abscesses form beneath the scalp, which early becomes œdematous. The cerebral symptoms may be comparatively slight, headache and vomiting being the chief phenomena. The only treatment practicable is an extensive decompression which lays bare the dura mater and removes the sequestra. In the cases mentioned above nearly half the cranium had to be removed in order to get clear of the trouble. The former case improved for a time, but died of acute mania, the latter case did very well, and fresh bone was formed over most of the denuded area.

(11) *Acute Diffuse Meningitis (lepto-meningitis)* is always infective in nature. The symptoms vary considerably in their intensity according to the site and method of inoculation and the activity of the organisms, but the whole pia arachnoid space is quickly involved. The superficial part of the brain is also invaded in the inflammation.

as well as the meninges and the term *meningo-encephalitis* would perhaps be the better appellation.

The Symptoms appear about forty-eight hours after an injury although sometimes infection may be delayed beyond this period. In the early stages the patient complains of severe constant and increasing headache associated with heat of head a forcible pulsation of the carotids a quick pulse and general irritability of the brain as indicated by vomiting intolerance of light and sound delirium and perhaps convulsive twitchings of the muscles not only of the head and back but also of the extremities. The vomiting is of the usual cerebral type i.e. it occurs without nausea and has no relation to the ingestion of food. High fever is generally present and possibly a rigor may occur at the onset. As the disease progresses the patient gradually becomes comatose the pulse is slow and full the respirations are laboured and death usually ensues in three or four days.

According to the site of infection the inflammatory phenomena may manifest themselves more acutely over one part than another and for descriptive purposes two chief varieties have been distinguished viz. meningitis of the convexity and meningitis of the base. The general symptoms are alike in both forms but when the convexity is involved convulsions are a more prominent feature in the case and may at first be limited to localized groups of muscles in basal meningitis the temperature usually runs higher the head and neck are more retracted optic neuritis is more frequent and some form of squint is not uncommonly observed.

On *post mortem* examination the skull-cap is separated from the meninges with some difficulty the dura mater is thick and congested and the subjacent veins are manifestly distended the cerebro-spinal fluid is increased in amount and turbid from admixture with lymph or pus the arachnoid is thick and opaque the surface of the convolutions is flattened and oedematous and lymph occupies all the sulci matting them together the cortical grey matter is usually red and congested the underlying white substance of the centrum ovale is injected the ventricles are distended with cerebro-spinal fluid and the choroid plexuses are engorged with blood.

The Treatment consists in shaving the head and applying cold by means of an icebag care being taken that the application is continuous and not intermittent. In the robust general venesection is useful but in weaker individuals purging and a low diet must be relied on. The patient should be kept absolutely quiet in a darkened room and every source of irritation and excitement removed. Even if recovery ensues it is often delayed and for a while incomplete especially as regards the mental powers and precautions as to quiet and freedom from worry and strain must be maintained for a long time. An abundance of sleep in restful surroundings is essential.

If the condition is due to a localized infective lesion this must of course be dealt with by suitable means e.g. the middle ear is opened up and diseased bone removed depressed fractures are operated on and localized drainage effected etc. Apart from this attempts have been frequently made to relieve the symptoms and determine a cure

by means of operative measures directed towards reducing the intra cranial tension, the subarachnoid space has been opened below the tentorium, whilst others have employed cisternal or lumbar puncture, repeating it frequently. When one considers the intricate character of the space to be drained, the fact that it is sure to be subdivided into separate cavities by deposits of lymph, and especially when it is remembered that the brain substance is itself swollen and that the important fourth ventricle has only a small communication with the subarachnoid space—all these considerations suggest that it is unlikely that much success will follow such treatment.

Acute Meningo-encephalitis is sometimes *limited* in character. It can only occur in the absence of tension diffusion along the meninges being prevented by the formation of adhesions. It usually results from a localized inflammation of bone (Fig 502) due to a contusion, a penetrating wound or possibly to middle ear mischief. The process ends in the formation of adhesions between the brain and its membranes preceded or not by supuration. Of course where pus forms a cure can only be established by operation.

(iii) A **Subacute** form of meningitis is occasionally met with coming on at a somewhat later date. The patient may have apparently recovered from his injury, with the exception of a fixed pain in the head. The onset of the symptoms is often due to some indiscretion, and may be gradual

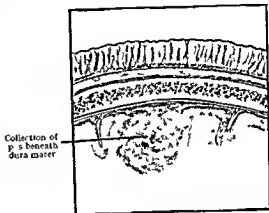


FIG 502 — SUPERFICIAL ABSCESS OF BRAIN SPREADING FROM SUBDURAL SPACE (SEMI DIAGRAMMATIC)

or sudden. In all probability this affection is also microbic in origin, and the delay in its appearance depends either on the small number of bacteria present or on their being in a low state of virulence or possibly they have been latent for a time, and are aroused into activity by secondary causes, or, again, they may have worked their way gradually inwards along lymphatics or vessels from the periphery to the meninges. The symptoms are similar in character to those of acute meningitis, though somewhat less severe, but a fatal result is very apt to follow. In the *treatment* of this form, no active antiphlogistic measures should be adopted, since the patient's condition is somewhat asthenic. Absolute rest and quiet are essential. Counter irritation should be applied to the scalp and neck, and possibly mercury administered, or some absorbent organic salt of iodine. Lumbar puncture may be useful, or a decompression may be desirable, if there be a local lesion, the

site of injury may be selected but apart from this an exploratory subtemporal decompression can be undertaken.

(iv) Chronic Lepto-meningitis arises from very similar causes to the pachymeningitis already described (p 887) but in addition may be associated with deep lesions and may serve to limit the spread of infection. It is usually of a protective character. Syphilitic patients are perhaps more liable to its development than others. It is evidenced by infiltration and thickening of the membranes which are usually adherent to one another and to the cerebral cortex. It gives rise to a localized headache which is constant and increased on excitement or the injudicious use of stimulants whilst tenderness is often noted on deep pressure and traumatic epilepsy may ensue. The treatment consists in attention to the general health, free action of the bowels, abstinence from excitement and stimulants, the local application of counter irritants and the administration of mercury. For the question of operating for traumatic epilepsy see p 913.

(v) Tuberculous Meningitis is a condition usually seen in children due to an invasion of the meninges with tubercle. The pial vessels are chiefly affected and the base of the brain is mainly involved. Inflammatory adhesions follow and the free circulation of the cerebro-spinal fluid is checked by the blocking of the foramina of Monro and Luschka so that the ventricles are often distended. For symptoms and clinical history medical textbooks must be consulted.

(vi.) Infective Thrombosis of the Sinuses though occasionally seen after injuries is more commonly associated with suppurative diseases of the bone apart from trauma and one variety is that affecting the lateral sinus is almost exclusively caused by disease of the middle ear. It is also induced by extension from scalp injuries as a complication of subaponeurotic cellulitis or may spread inwards from erysipelatous or pyogenic lesions of the face or suppurative conditions of the nose. Putting aside the results of chronic otorrhoea the cavernous sinus is much more frequently involved than any other and this affection is often secondary to suppuration in the sphenoidal or ethmoidal sinuses.

Pathologically the same manifestations are observed as in any case of infective phlebitis. The sinus becomes impervious owing to thrombosis which may develop slowly or suddenly, the clot becoming disintegrated gives rise to multiple emboli whilst various inflammatory conditions of the surrounding tissues necessarily result e.g. necrosis or caries of bones, subcranial abscess, meningitis, simple and localized or infective and diffuse or even cerebral or cerebellar abscess.

The symptoms are mainly of a pyæmic nature. The temperature is high but with remissions and often with repeated rigors, fixed headache and early and continuous vomiting are also marked features of the case. With these may be associated evidences of meningeal mischief or of pulmonary trouble in the shape of dyspnoea but sometimes diarrhoea and septicæmic manifestations may be the more prominent.

If the cavernous sinus is involved marked exophthalmos with congestion of the orbit and even of the eyelids and face may result

and ptosis or squint may also be set up by implication of the nerves which lie in the walls of the sinus

During the late war many cases of thrombosis of the superior longitudinal sinus were observed, resulting from wounds by a bullet or shrapnel fragment. The symptoms included bilateral loss of power of the lower limbs more marked distally, loss of cortical sensation, and such pyramidal symptoms as an extensor plantar response (Babinski), ankle clonus, etc. In addition there may be turgescence of the veins of the scalp and forehead, together with tenderness along the line of the sinus and epistaxis.

For local results and treatment of thrombosis of the lateral sinus, see Chapter XLIX.

Treatment, except for the lateral sinus, is but rarely possible, and hence the importance of preventing this disease by a most careful attention to asepsis in the surgery of the face and of the nasal cavity. For the lateral sinus much can be done, but for the other sinuses all that is feasible is attention to general measures.

Abcess of the Brain.

Causes—Pyogenic infection is of course, the ultimate cause of all cerebral suppuration, but the manner in which the organisms find their way to the brain varies considerably.

(1) It may be due to *traumatism*, either in the early or late stages of head injuries. In the *early* it is usually superficial, and connected with some infective lesion of the scalp, cranium, or membranes, with or without a penetrating wound (Fig. 502). In the *later* stages the pus forms deeply in the white substance. It may be due to a penetrating wound, whether a foreign body is present or not, the microbes finding their way into the interior of the brain either through the track of the missile, or along blood vessels or their pia arachnoid sheaths. Some times it occurs apart from penetration, and then is due to auto-infection of a contused or lacerated area. Chronic abscess of this type is most frequently seen on the same side of the brain as the lesion, and the parietal and frontal lobes are most often affected, occasionally, however it may occur on the opposite side in the same way as a contusion.

(2) It arises by extension of an infective lesion from without the organisms reaching the brain by direct continuity of tissue, or by way of the blood vessels. The commonest cause of all abscesses in the brain is *chronic otorrhœa* (Fig. 503), and the cerebellum is nearly as frequently involved as the cerebrum. In the former the abscess is usually in the anterior portion of the lateral lobe (D), close to the back of the petrous bone, whilst in the latter the posterior portion of the temporo-sphenoidal lobe is most frequently affected. The inflammation may spread directly from the tympanic cavity or inner aspect of the mastoid process through the bone to the membranes, which become adherent to the brain, and then into the cerebral substance. Occasionally a subcranial abscess is first developed (Fig. 503 B), and the cerebral affection follows, sometimes a direct opening has been

found through the tegmen tympani into an abscess cavity and the abscess has even discharged itself and been drained in this direction. More commonly a layer of brain tissue intervenes between the membranes and the pus and then infection must have been carried along the vessels and their sheaths.

Abscesses of a similar type occur in connection with suppuration in the frontal sinus the abscess being usually acute and secondary

to a frontal osteomyelitis and occupying the anterior portion of the frontal lobe it may also follow purulent infection of the sphenoidal and ethmoidal sinuses or thrombosis of the cavernous sinus (See Plate VI)

(iii) The infective material may be brought to the brain by the blood in pyæmia or after some of the exanthemata such as scarlatina typhoid etc. Abscess of the occipital lobe is almost always of pyæmic origin. In suppurative conditions in the chest pyæmic abscesses of the brain are not uncommon.

(iv) A chronic abscess of tuberculous origin may also occur.

A cerebral abscess is usually single occasionally more than one is present e.g. a cerebral and cerebellar may co-exist in connection with middle-ear mischief. The course taken by the case is generally chronic and then the pus is encapsuled in acute cases there is usually no limiting membrane.

The Symptoms vary somewhat with the method of onset and the characters of the abscess. If traumatic and due to infection from without the case runs an acute course associated with in-

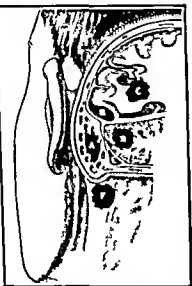


FIG. 503.—DIAGRAM TO REPRESENT THE COURSE OF INFLAMMATORY TROUBLE FROM SUPPURATIVE DISEASE OF THE MIDDLE EAR.

A Dilated and infected mastoid antrum B subcranial (intradural) abscess from infect on through the roof of middle ear or mastoid C abscess in temporo-sphenoidal lobe D cerebellar abscess E lateral sinus F Bezold's abscess through perforation of tip of mastoid process

tense pain in the head recurrent rigors and rapid development of coma. Diffuse meningitis is often present and the two conditions can scarcely be distinguished. In not a few of the cases of chronic abscess all that the patient complains of is headache until suddenly the temperature rises with a bound he becomes unconscious and dies within a day or two. Such a course of events is probably due to the bursting of the abscess into the lateral ventricle or meningeal cavity or to the onset of an acute spreading oedema.

PLATE VI



Large frontal abscess of the brain secondary to suppuration
in the frontal sinus

(Mr E D D Davis Case)

When the symptoms are more characteristic, there are three well-marked stages (i) In the *Initiatory Stage*, which lasts from twelve hours to two or three days the patient is suddenly seized with severe pain in the region of the ear, radiating perhaps throughout the head, and accompanied by a rigor of some severity. The temperature and pulse are both raised and vomiting of a cerebral type is present, the tongue is foul, whilst anorexia and constipation are well marked. During this period the otorrhœa diminishes or ceases entirely.

(ii) In the *Fully-developed Stage* the patient lies quietly in bed in a dull, apathetic condition able to answer questions but slowly, and with his brain evidently in a torpid state. The headache has to a great extent ceased, but tenderness over the temporo-mastoid region still remains. The temperature falls gradually and becomes sub normal, the pulse is slow and full and respiration is usually slow. The vomiting and constipation continue, and the patient's mouth and breath become very offensive. Loss of muscular power scarcely amounting to paralysis occurs in many cases where the motor track is involved, and the order in which this paresis appears is of localizing value. Thus, if a temporo-sphenoidal abscess is not far from the cortex, the face is first affected, then the arm, and finally the leg; but if the abscess is deeper and presses on the motor fibres in the internal capsule, the order in which these parts are involved is reversed. Motor aphasia is sometimes well marked when the abscess is on the left side. If the abscess is placed posteriorly, it may press on the cerebellum through the tentorium, and cause symptoms of a cerebellar type. Papilloedema (p 903) is a somewhat unreliable sign, but if present is more marked on the affected side, whilst the corresponding pupil is dilated and fixed.

(iii) The *Terminal Stage* is marked by a gradually increasing unconsciousness and death, or the abscess may burst into the lateral ventricle, causing sudden coma, a rapid rise of temperature and pulse, irregular respirations (often of a Cheyne-Stokes type), and death, or it may burst into the subarachnoid space, and then death is preceded by symptoms of diffuse lepto meningitis.

The signs connected with a small *Cerebellar Abscess* (Fig 503, D) are often very indefinite and vague, but as the abscess increases in size the symptoms may become very characteristic. The patient complains of giddiness, and staggers when attempting to walk, falling towards the opposite side. The head and neck are retracted, respiration is irregular and feeble, the pulse is often slow and weak, paralysis may be noted on one or both sides of the body, and may only affect the upper extremity, of course, vomiting, optic neuritis, and a low temperature are present.

Diagnosis—From *meningitis*, a cerebral abscess is usually recognized by the fact that in the former condition irritative phenomena, such as acute and active delirium, contraction of the pupil, photophobia, rigidity and spasm of muscles, especially in the back of the neck, and severe pain are more evident and are produced earlier. The temperature is usually high, and mental dulness comes on within three or four days of an injury, whereas an abscess rarely forms before

the end of the first week. *Extradural abscess* (subcranial) is associated with a high temperature earlier onset after an injury in traumatic cases and more rapid compression symptoms optic neuritis is unusual and the vomiting is less troublesome. Localized œdema of the scalp may be present or tenderness on deep pressure. In *thrombosis of the lateral sinus* the temperature is high and oscillating optic neuritis may be absent and there may be tenderness in the neck along the course of the internal jugular in abscess symptoms of compression are associated with a low temperature and marked optic neuritis. It must not be forgotten that the two conditions may co-exist. It is often impossible to diagnose between a chronic abscess and a *tumour of the brain* the symptoms in the latter usually come on more slowly than in the former but the progress is steady and unrelenting the temperature remains near the normal and there is less gastric disturbance. The history of the case and white blood count may throw some light upon its nature since in cases of cerebral abscess there is generally some causative focus of infection. Tumour is more common in the frontal and parietal regions abscess in the temporo-sphenoidal lobe. Papilloedema is more marked and more common in tumour than in abscess.

Treatment necessarily follows the usual rule *viz.* to give an exit to the pus as soon as possible no delay is permissible when once the diagnosis is certain. The patient is prepared in the same way as for operation on a cerebral tumour (p. 904). A flap of scalp tissue is raised and in such a manner as will serve most effectively for subsequent drainage purposes. A gouge trephine or burr is applied in accordance with the special indications given by the symptoms of the case. When the circle of bone has been removed the exposed surface and cut edge should be well rubbed over with powdered iodoform and boric acid or with Bipp so as to guard them from infection. The dura mater which bulges into the wound and does not pulsate is then carefully incised. A mere slit often suffices and this may open the abscess but more usually the brain substance protrudes. It is carefully explored with a pair of sinus forceps which is passed directly into it in various directions or with a fine trocar and cannula. In a temporo-sphenoidal abscess the most likely direction to explore is downwards and inwards towards the tegmen tympani. Pus when discovered is allowed to escape by opening the blades of the sinus forceps. Sloughs are not uncommonly present in the cavity and are removed by gentle irrigation with sterilized salt solution or by being sucked up through a catheter. A drainage-tube is advisably inserted and may be kept in position by stitching it to the margins of the incision in the dura which is closed except for the passage of the tube. Sometimes it is wiser not to close the flaps around the tube but to pack gauze round it thereby determining the formation of adhesions which will serve to shut off and guard from infection the meningeal cavity. The scalp flap is replaced in position the tube being brought out through its centre if need be. The tube is retained in position for two or three days and is then removed. Symptoms of re-accumulation or of extension of the mischief to the

meninges will of course necessitate a re opening of the wound and the institution of free and effective drainage. Occasionally a hernia cerebri develops as the result of opening a cerebral abscess.

In middle ear disease diagnosis both as to the presence of an abscess and its situation is often doubtful. The antrum and attic are then opened and explored thoroughly and according to whether the disease is more marked in the former or latter the further steps of the operation are directed towards the cerebellum or cerebrum. By carefully removing bone behind and above the antrum the lateral sinus is exposed and by working above or below it the cerebrum or cerebellum can be examined and if need be incised.

In those cases where the abscess is secondary to suppuration within the chest its actual localization may be difficult but ventriculography may help in placing the site of the lesion. In these cases the method advocated by Clovis Vincent may be adopted with advantage. This consists of making a large osteoplastic flap over the site of the abscess the dura mater is not opened but the abscess is aspirated and the bone flap replaced. After a few weeks when the abscess has become encapsulated the osteoplastic flap is again raised and the whole encysted abscess cavity is dissected out.

Intracranial Tumours

Broadly speaking intracranial tumours may be divided into those which are benign and those which are malignant.

The chief varieties of the non malignant tumours are as follows

(1) **Meningioma (Endothelioma)**

is a tumour characteristic of adult life occurring most commonly in the para sagittal central region.

Their other common sites are near the cribriform plate of the ethmoid near the basi sphenoid and in the temporal fossa (Fig 504). They account for about 15 per cent of all cerebral tumours. These tumours are now known to arise on the arachnoid granulations and hence their common occurrence in the para sagittal region by the venous laminae (see Fig 505). The tumour is usually a rounded mass sharply defined and firmly attached to the dura mater (Fig 506). The cerebral tissue is not invaded but is compressed by the growing tumour. Large vessels enter and leave the tumour from the pial circulation. On section the tumour is seen to be composed of a firm whitish consistency (Fig 506). Histologically these tumours are characterized

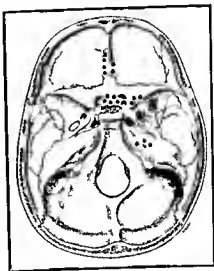


FIG 504—THE BASE OF THE SKULL SHOWING THE COMMON SITES FOR MENINGIOMAS

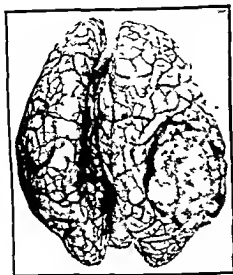


FIG 505 — PHOTOGRAPH OF BRAIN SHOWING A LARGE MENINGIOMA IN THE RIGHT PARIETAL REGION



FIG 506 — LARGE PARA SAGITTAL MENINGIOMA REMOVED FROM A MAN AGED FORTY EIGHT YEARS
The tumour has been cut into two pieces

by the whorl formation of their cells which are often elongated with scanty cytoplasm and a vesicular nucleus (Fig 507). When calcium is deposited in the centre of the whorls a typical picture of psammoma bodies is produced.

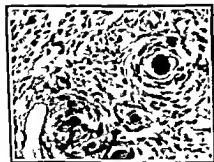


FIG 507 — MICROPHOTOGRAPH OF MENINGIOMA SHOWING PSAMMOMA FORMATION

The meningiomata commonly invade the cranial bones. Growth is slow but late in appearing. Attacks of twitchings, paresis or loss of sensation may be the first sign, commonly in the foot and lower limbs and subsequently spreading up one side of the body. Changes in the cranial vault may be palpable; there may be local erosion and hyperostosis; a bruit may be heard, and the tumours are frequently

highly vascular. When a rise of intracranial tension is found the tumour is usually large. These tumours are essentially benign; they grow locally and they invade only the skull bones by pressure. They

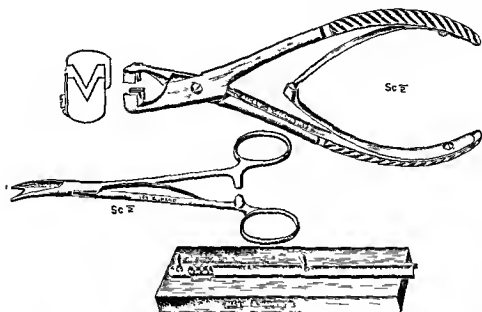


FIG 308—WIRE SUTURE SET CONSISTING OF FORCEPS FOR SHAPING AND CUTTING THE CLIPS | FORCEPS FOR HOLDING AND APPLYING THE CLIPS AND A CARRIER WITH SLIDING COVER AND HEAVY BASE FOR HOLDING CLIPS

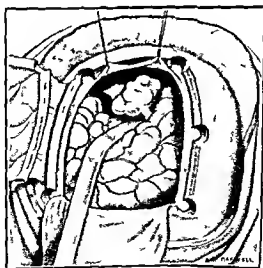


FIG 509—MENINGIOMA OF LEFT SPHENOIDAL RIDGE
Drawing made at time of operation

do not metastasize and when completely removed they do not recur. They compress the cerebral tissue in their vicinity but when this compression is removed the cerebral tissue resumes function in a dramatic way.

The treatment of these tumours is removal. This may however be difficult owing to two reasons.

(a) Vascularity of the tumour. The control of its blood supply may tax the surgeon's ingenuity to the utmost. Multiple-stage

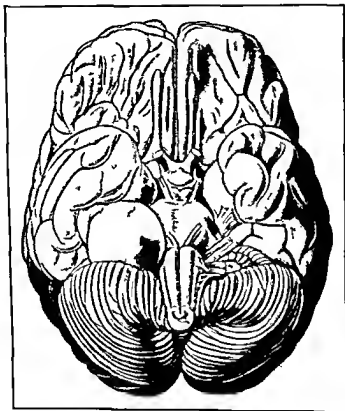


FIG. 510.—LARGE RIGHT ACOUSTIC NERVE TUMOUR SHOWING ITS RELATION TO THE PONS AND CEREBELLUM.

operations may be necessary. Recourse may be had to silver clips (Fig. 508) muscle grafts and electro-coagulation (p. 293).

(b) Inaccessibility of the tumour. This also presents a stumbling block and special operative methods may have to be devised. The tumour may be in the region of the olfactory groove the cavernous sinus or behind the entrance of the superior cerebral veins (which should not be ligatured for fear of paraplegia) (Fig. 509).

Successful removal is, however most gratifying. The patient is completely cured, and has been rescued from a progressive loss of cerebral function which would end in death.

(2) **Acoustic Nerve Tumours** are neuro fibromata which grow from the sheath of the auditory nerve in the region of the cerebello pontine angle, and press against the internal auditory meatus (Fig 510). They are small at first and quite localized but cause grave symptoms out of all proportion to their size. Deafness, tinnitus, and vertigo are early signs, which are followed by facial spasm, irritation, and weakness. There may be diplopia and paræsthesia of the fifth nerve. As the tumour grows it gradually excavates the bone forming the internal auditory meatus and this can often be demonstrated radio

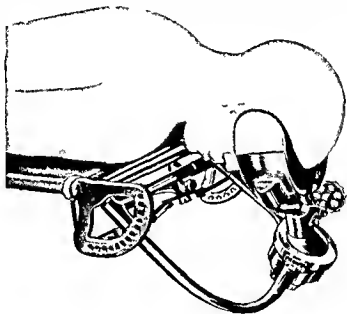


FIG 511 — DIAGRAM SHOWING SPECIAL HEAD CLAMP AND PATIENT IN POSITION FOR A CEREBELLAR EXPOSURE

graphically in good skiagrams. In generalized neuro fibromatosis acoustic nerve tumours may be found, and are not infrequently bilateral.

These tumours should be explored by the suboccipital route. The patient is placed face downwards on the operation table and the head firmly grasped in a head piece which is lined with sorbo rubber (Fig 511). Avertin anæsthesia should be employed, followed by intratracheal gas and oxygen, the scalp being anæsthetized with $\frac{1}{2}$ per cent novocaine. The cerebellar fossæ are exposed by means of either a 'cross bow' incision (Fig 512) or a median vertical one (Fig 513). If there is much increase in the intracranial tension it is a wise precaution to tap the lateral ventricles (Fig 514) before the

dura mater is incised. When the dura mater is opened (Fig 515) the cerebellar hemisphere is gently retracted, or, if necessary, a portion



FIG 512.—CROSS BOW INCISION FOR CEREBELLAR EXPOSURE



FIG 513.—VERTICAL INCISION WHICH GIVES GOOD ACCESS IN CEREBELLAR OPERATIONS

of it is amputated and the cerebello-pontine angle exposed. The tumour is pinkish grey in colour, and lies closely applied to the petrous

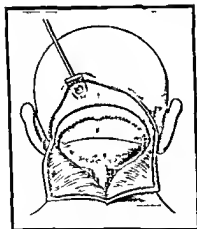


FIG 514.—CEREBELLAR EXPOSURE THROUGH A CROSS BOW INCISION

The lateral ventricle has been tapped. The line of incision through the bulging dura mater can be seen

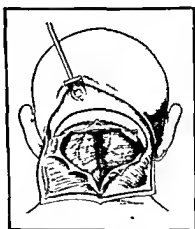


FIG 515

The dura mater has been incised exposing the cerebellar hemisphere.

portion of the temporal bone. An arachnoid cyst is frequently found in front of the tumour, and the surgeon must traverse this to

expose the tumour. Numerous vessels run over the surface of the tumour and blend with the capsule. The fifth seventh ninth tenth and eleventh cranial nerves are stretched out by the tumour and may also blend with the capsule. It is for this reason that complete removal of the tumour is impossible. The present day procedure is to incise the capsule and with a curette remove the contents which are usually very soft and easily removed. This allows the capsule to



FIG. 516.—ANTERO POSTERIOR SKIAGRAM OF SKULL SHOWING LARGE ANGIOMA OF THE OCCIPITAL CORTEX ON THE LEFT SIDE

collapse with complete relief of pressure symptoms. The acoustic nerve however usually remains paralyzed.

- (3) Pituitary Adenomas are dealt with on p. 906
- (4) Hypophyseal Duct Tumours, also known as craniopharyngiomas or Rathke's pouch tumours are of congenital origin and account for 4 per cent. of all intracranial tumours. They are situated above or within the sella turcica or in the floor of the third ventricle. Although they grow to a large size they remain benign encapsulated tumours which are usually cystic and calcification is common so that diagnosis

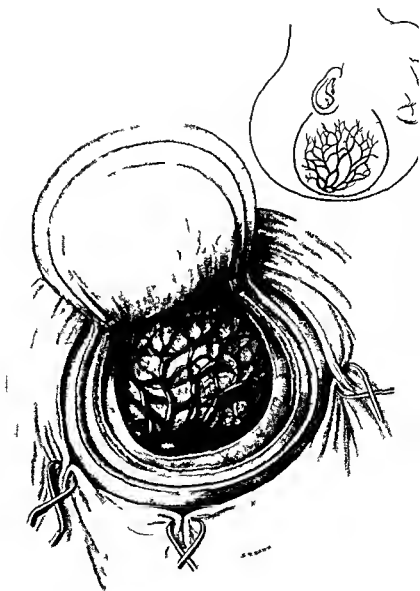
is facilitated by X ray examination. These tumours occur most frequently in children and are derived from developmental cell rests. They should be exposed through a transfrontal approach (see p 910). The cystic tumour should be punctured and its contents aspirated and then an attempt should be made to remove the cyst wall piecemeal. If the cyst is very large puncture and sudden decompression may cause very unpleasant symptoms from subthalamie interference—hyperthermia coma etc.



FIG 517—ANTERIOR POSTERIOR SKIAGRAM OF THE SKULL SHOWING CALCIFICATION IN THE CHOROID PLEXUS

(5) **Blood vessel Tumours** account for 2 per cent of intracranial tumours and they fall into two main types (a) Angiomatous malformations due to abnormal development of the cerebral vessels. These may be chiefly capillary (cerebral telangiectases) venous or arterio venous. These tumours are not infrequently associated with facial cutaneous naevi. The arterio venous tumours may cause a bruit which is audible both to patient and surgeon. Unilateral exophthalmos and papilloedema may be associated (Fig 516)

PLATE XII



Vascular tumour of the Brain
(The small drawing shows the extent of the incision)

(b) The other type of tumour is known as the angioblastoma. These tumours are often cystic they are found almost invariably in the cerebellum at the posterior end of the roof of the fourth ventricle. These are the tumours which may be associated with angiomatosis of the retina (Iridau's disease).

The first type of tumour should be treated by a surgical exploration and perhaps cautery or occlusion with clips of any main vessels followed by irradiation (see Plate XII). It is impossible to remove the tumour completely. The hemangioblastomas on the other hand may be extirpated surgically though bleeding may be troublesome during removal. The usual suboccipital exposure of the cerebellum is used.

(6) Non-malignant Gliomas form a small group probably not more than 5 per cent. of the large groups of gliomas. Cerebellar astrocytoma may be classed under this heading. It is usually cystic and of slow growth occurring more often in the vermis of the cerebellum than in the lateral lobe.

The ependymoma of the fourth ventricle is another benign glioma.

(7) Other Non-malignant Tumours are chorionomas, cholesteatomas, dermoid cysts and teratomas and papillomas of the choroid plexus. The papillomas of choroid plexus may give rise to calcification in the plexus itself (Fig 517) which can be seen in X-ray films.

(8) Granulomata are included under the heading of tumours because clinically they give rise to symptoms which cannot be differentiated from true tumour formation.

Tuberculomas although common fifty years ago are now becoming excessively rare. They are met with in children most commonly in the cerebellum and vary in size considerably and may be either firm and caseous or with a diffuent centre. They may develop active signs after lengthy periods of quiescence. Any attempt at surgical removal will cause tuberculous meningitis. A wide cerebellar decompression followed by heliotherapy should be the treatment adopted in these cases.

Gummata of the Brain usually spring from the meninges and are more irregular in shape than tuberculous masses. They are frequently multiple and are seldom seen in children. Like the tuberculomas they are getting rarer and since the intravenous arsenical preparations have been used in the treatment of syphilis their occurrence is almost unknown in the brain.

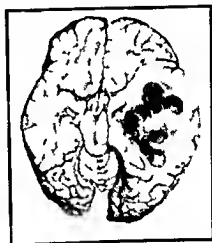


FIG 518 — SPONGIOBLASTOMA MULTIFORME

The Malignant Tumours consist for the most part of the gliomas, which constitute fully 50 per cent of all intracranial tumours. The gliomas have been divided into numerous sub-classes especially by American writers chiefly according to the predominating cell type. It must be remembered however, that these are not all pure cell tumours, many varieties of cells being found in each tumour. Several definite sub-classes however are commonly recognized.

(a) Spongioblastoma Multiforme is the commonest variety of the glioma group. The tumour is of rapid growth and is confined almost exclusively to the cerebral hemispheres. The tumour may grow to a large size and may contain areas of necrosis and multiple cysts (Fig 518). These tumours are only found in adults and are radio-resistant.

(b) Medulloblastoma is an uncommon tumour which occurs in children. The common site is the vermis of the cerebellum. The

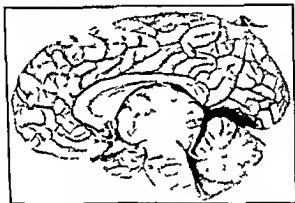


FIG 519.—PHOTOGRAPH OF BRAIN SHOWING PINEALOMA

tumour is very invasive and tends to spread in the arachnoid and pia mater. It may thus spread over the whole cerebellum and down the spinal cord, nodules being found even in the cauda equina roots. These tumours are the most rapidly growing of all the glioma group.

(c) Astrocytoma is the most indolent of the glioma group and therefore carries the best prognosis. The tumour is of slow growth and is relatively non vascular. It has a tendency to cystic formation and at times calcification.

(d) Other gliomas are uncommon but astroblastomas and oligodendrogliomas may be met with in the cerebral hemispheres.

(e) Pineal Tumours are not so uncommon as they are supposed, and they account for about 3 per cent of intracranial neoplasms. Owing to their proximity to the corpora quadrigemina these tumours give rise to a definite pineal syndrome which is associated with impairment of the upward gaze or with skew deviation of the eyes. This

is due to pressure on the anterior corpora quadrigemina. As the pineal tumour increases in size the aqueduct is pressed upon, and an internal hydrocephalus is produced. The nuclei of the third nerves which are situated in the periaqueductal region become pressed

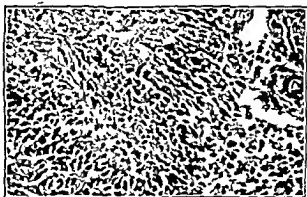


FIG 520 —MICROPHOTOGRAPH OF PINEALOMA (LOW POWER)

upon, and thus produces disturbances in the intrinsic and extrinsic musculature of the eyes. Pineal tumours may be divided into two classes: the pinealomas and the pineal teratomas. The pinealomas, or 'pineoblastomas' as they have often been called, are large tumours (Fig 521), and they have a characteristic microscopical appearance

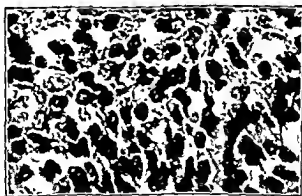


FIG 521 —MICROPHOTOGRAPH OF PINEALOMA (HIGH POWER)

(Figs 520 and 521) There are large masses of spherical epithelioid cells of quite considerable size, and these are separated by a fine network of reticular connective tissue in which there are lymphoid cells. The large cells are often called 'pineal parenchyma' cells.

The pineal teratomas are more rare, and are also more or less typical

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(b) **Medulloblastoma** is an uncommon tumour which occurs in children. The common site is the vermis of the cerebellum. The

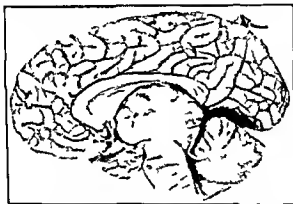


FIG 519—PHOTOGRAPH OF BRAIN SHOWING PINEALOMA

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(e) **Pineal Tumours** are not so uncommon as they are supposed and they account for about 3 per cent of intracranial neoplasms. Owing to their proximity to the corpora quadrigemina these tumours give rise to a definite pineal syndrome which is associated with impairment of the upward gaze or with skew deviation of the eyes. This

is due to pressure on the anterior corpora quadrigemina. As the pineal tumour increases in size the aqueduct is pressed upon and an internal hydrocephalus is produced. The nuclei of the third nerves which are situated in the periaqueductal region become pressed

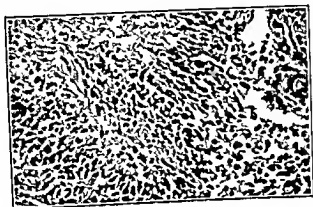


FIG 520 —MICROPHOTOGRAPH OF PINEALOMA (LOW POWER)

upon and this produces disturbances in the intrinsic and extrinsic musculature of the eyes. Pineal tumours may be divided into two classes the pinealomas and the pineal teratomas. The pinealomas, or pineoblastomas as they have often been called are large tumours (Fig 519) and they have a characteristic microscopical appearance

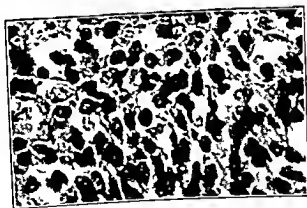


FIG 521 —MICROPHOTOGRAPH OF PINEALOMA (HIGH POWER)

(Figs 520 and 521) There are large masses of spherical epithelioid cells of quite considerable size and these are separated by a fine network of reticular connective tissue in which there are lymphoid cells. The large cells are often called pineal parenchyma cells.

The pineal teratomas are more rare and are also more or less typical

in their histological appearance. Sections reveal multiple cysts or tumours, consisting of a variety of cells, and often containing cholesterol crystals.

Tumours of the Optic Nerves and Chiasma.

Although these are uncommon, they are more frequent than is usually thought. They are slowly growing gliomas which often cause an enlargement of the optic foramina (Fig 522) which may be diagnosed by modern skiagrams. There is usually optic atrophy and a ventriculogram may show a deformity of the anterior portion of the third ventricle (Fig 523).

Metastatic Tumours are more common than is generally supposed, and form about 10 per cent of all intracranial new growths, they may



FIG 522—GLIOMA OF RIGHT OPTIC NERVE

Drawing made at time of operation.



FIG 523—DRAWING FROM VENTRICULOGRAM

The dotted area shows the obliteration of the third ventricle by an optic nerve glioma.

be carcinomas, sarcomas, or hypernephromas. The commonest by far are the secondary growths resulting from a primary carcinoma in the bronchus. The possibility of a secondary deposit in the brain must always be considered when a patient develops cerebral symptoms after an operation for primary carcinoma, especially when the primary focus is in the thyroid or the breast.

The Symptoms of a cerebral tumour in the early stages are comparatively seldom brought under the notice of the surgeon, but it is of the greatest importance that their significance should be recognized by the general practitioner, who ought, in case of doubt, at once to obtain the assistance of a skilled neurologist, as it is only through unproved and earlier diagnosis that we may hope for better surgical results. It is quite possible for a tumour to attain considerable dimensions before causing serious symptoms, the brain can accommodate itself to increased pressure in an astonishing

fashion so long as the circulation is not unduly disturbed. Supratentorial tumours usually conform to this requirement and hence may already be of large size when the patient comes under observation or before they cause serious pressure. Subtentorial tumours on the other hand are likely early to encroach on the fourth ventricle or aqueduct of Sylvius thereby causing back pressure within the lateral ventricles and bringing about the grave terminal phenomena. When these have appeared the time has usually passed for successful interference except in a few cases of subtentorial origin.

The early symptoms consist in some localized modification of the cerebral function probably combined with headache and perhaps vomiting. The character of the *localizing phenomena* varies of course with the part of the brain involved thus if the cortex of the motor area is affected Jacksonian epilepsy is likely to result in which a definite aura associated with a particular movement precedes the fit which develops in an orderly fashion in the later stages the fits are replaced by paralysis and a localized monoplegia may be an important sign of a cerebral tumour. A subcortical lesion produces localized paralysis without convulsions. Motor aphasia would suggest an affection of Broca's lobe word deafness an implication of the hinder end of the temporal lobe and homonymous hemianopsia a lesion of the occipital region. Interference with co-ordination vertigo and nystagmus point to mischief in the cerebellum and the association of these phenomena with localized lesions of cranial nerves especially of the seventh or eighth points to the cerebello-pontine angle. The *headache* varies much in character but is usually localized occurs in paroxysmal attacks and may be associated with local tenderness on deep pressure if syphilitic in origin. It is increased by anything that causes passive congestion of the brain such as coughing and the sites of maximum pain and of the tumour often correspond. *Vomiting* if present is of the usual cerebral type i.e. it bears no relation to the ingestion of food and is not preceded by nausea.

The later phenomena are purely those due to intracranial tension which may aggravate or to some extent mask the localizing signs. Headache becomes more severe and persistent vomiting and constipation are well marked the patient becomes drowsy and apathetic wasting rapidly and the temperature is subnormal. Papilloedema is generally present and at first more marked on the side of the tumour. It is due to increased tension of cerebro spinal fluid which is thereby forced into the sheath of the optic nerve and produces a condition of oedema which extends to the lamina cribrosa and causes serious interference with the return of blood and lymph from the retina. There is in reality no inflammatory element about it. In the earlier stages the margins of the disc become blurred and indistinct and the retinal veins congested and tortuous the neighbouring retina is oedematous and the vessels are only seen at intervals linear ecchymoses may also occur. The vision may at first be but little affected but if the case persists atrophy of the disc and blindness follow even in cases of gummata which have been cured by medicine if that cure has not been attained quickly.

The terminal phenomena of a cerebral tumour are gradually increasing coma and the supervention of symptoms similar to those of compression (p 867) whilst the temperature may be subnormal or occasionally very high. Sudden death is not infrequent.

Treatment—In every case the possibility of the symptoms being due to gummatous disease must not be forgotten and a test for the Wassermann reaction should always be undertaken if positive an intravenous injection of salvarsan may be given or large and increasing doses of iodide of potassium (even up to 40 or 60 grains three or four times a day) should be administered before undertaking operative proceedings. But time must not be lost if the patient's condition does not rapidly improve then operation should be performed. Symptoms of gastric irritation must be prevented by giving some alkaline carbonate (especially the ammonium or soda salts) whilst the dose should be freely diluted with water.



FIG 524 EXTENT OF INCISION IN
A CASE OF LARGE PRE ROLANDIC
GLIOMA

Operation should be undertaken as early as possible since even if no tumour is discovered the patient runs but little risk whilst delay may render it irremovable. For details larger textbooks must be consulted but a few general points may be noted. Infiltration anaesthesia should be induced by the use of 1 per cent novocaine and adrenalin. If a general anaesthetic has to be employed intra-tracheal gas and oxygen should be given. The skull is opened by turning down a large osteoplastic flap (Fig 524) and with focal anaesthesia the loss of blood is so much diminished that there is often no need to delay till a later date the subsequent steps. The dura is incised and the brain exposed. It

is gently explored by a grooved needle each stab being made exactly at right angles to the surface. If however a cortical neoplasm is found it is isolated from the surrounding brain substance by a dissector all bleeding being controlled by the coagulating electrode of an electro-surgical unit. The dura mater is then loosely approximated and the wound closed without drainage. After the operation the patient must be kept absolutely quiet with the head slightly raised. The drainage-tube is removed in twenty four or forty-eight hours and the scalp wound is usually healed in six or seven days.

When the tumour is inaccessible or irremovable or its situation doubtful temporary benefit often results from *decompression*—an operation which consists in removing large areas of the cranium and incising the dura mater so as to allow a hernia cerebri to form. The

decompression is best undertaken over the supposed site of the tumour but has sometimes been subtentorial with a view to influencing beneficially the vital centres. An intensive course of X ray treatments is then given over the decompression area. A considerable measure of benefit follows such operations as evidenced by an improved mental condition, loss of pain, retrogression of the papilloedema and the preservation of sight. Of course sooner or later the continued growth of the tumour results in the patient's death.

In dealing with cerebellar tumours or those in the neighbourhood either by removal or decompression Cushing's cross bow incision may be employed. It consists of a curved incision with its concavity downwards passing along the superior curved line of the occipital bone and from its centre passes down a vertical incision as far as is necessary in order to reflect the muscles from the posterior aspect of the atlas. Removal of fibromata from the cerebello pontine angle should be undertaken very slowly by *morcellement* and suction owing to the proximity of vital centres.

Meningiomas require adequate exposure and because of their vascularity it is necessary to be prepared to give a blood transfusion at any time during or after the operation. If the tumour is very large it is often a good plan to gouge out its interior with an electro surgical loop. As the result of such treatment the tumour shrinks up and its complete removal presents little difficulty. If the tumour is situated on both sides of the longitudinal sinus and is anterior to the lateral communicating veins the whole tumour with the falx and the sinus may be resected without producing motor or sensory paralysis. If however the tumour is placed posteriorly to the lateral communicating veins removal of the longitudinal sinus will result in paralysis and therefore this structure should be carefully preserved although complete removal of the tumour may thereby be rendered impossible. In such cases post operative radiation therapy should be given with the object of completely destroying any tumour cells. In cases where a large hypertrophied osteoma of the skull overlies a parasagittal meningioma the surgeon can trim off the hypertrophied bone, boil the newly fashioned bone flap for half an hour and then replace it.

At times meningiomas may arise on the tentorium in which case they must be resected with that structure. If bleeding cannot be stopped with ordinary methods a muscle flap from the gluteal region can be cut and applied to the cavity from which the tumour has been removed.

There are two methods of approach to pineal tumours, and both demand a large right occipito parietal osteoplastic flap. Dandy's approach is the operation of choice. The dura mater is opened widely as a flap and turned downwards. After the cerebral veins have been divided the whole of the posterior extremity of the hemisphere is retracted to such an extent as to expose the falx cerebri. A useful brain retractor which also combines suction and illumination in one is seen in Fig 525. Continued retraction will bring the inferior longitudinal sinus into view and beneath it the corpus callosum. In order to obtain adequate retraction without damaging the cortex of

the hemisphere, it is always necessary to tap the lateral ventricle. To obtain an adequate exposure of the splenium of the corpus callosum, it is often advisable to divide the inferior longitudinal sinus between silver clips, and then slit up the lower border of the falx for half an inch or more. The splenium of the corpus callosum is then incised in the mid line and the tumour exposed. The most important structure in relation to the tumour is the great vein of Galen, which lies under the fornix. This vein and its tributaries should be carefully preserved. The tumour must be carefully dissected out. In this procedure the third ventricle is sometimes opened. All bleeding is controlled by the application of silver clips or the use of the diathermy

point. The posterior part of the cerebral hemisphere is allowed to fall back into place, and the dura mater sutured with one or two tethering sutures. Drainage for a day or so is often necessary. The osteoplastic flap is replaced and the scalp sutured.

The second method of surgical removal of a pineal tumour is that devised by Van Wagenen, in which the tumour is attacked through the dilated lateral ventricle. This is an easier method, because as soon as the ventricle is opened the tumour can be seen bulging through the median wall of the ventricle. The disadvantage of this method is that it usually leaves some permanent disturbance of function in the form of hemiplegia and homonymous hemianopia.

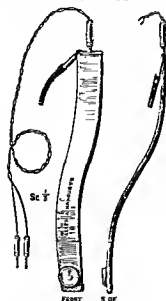


FIG 525—THE WAKELEY RE-
TRACTOR ILLUMINATED RETRACTOR
AND SUCKER

Tumours of the Pituitary Gland, or Hypophysis Cerebri.

The pituitary is a peculiar ductless gland in many respects. The anterior and posterior portions are developed in different ways and have a particular histology, each producing a distinct hormone.

The anterior lobe is derived from an outgrowth, or diverticulum (pouch of Rathke) of the primitive pharynx, and its secretion is discharged into the blood-stream, an increase of this secretion produces gigantism if it occurs before the epiphyses have joined, and acromegaly if full growth has been reached. If there is hypopituitarism, sexual desire and potency are lost, and an early sign of the disease in females is amenorrhœa. Metabolism is also affected, showing a close connection with the thyroid gland, in hypopituitarism it is diminished, and in hyperpituitarism it is increased.

The posterior lobe is developed as a funnel-shaped sac from the

floor of the third ventricle of the brain and consists of a mixture of epithelial and nervous elements. There is some evidence that the secretion of this portion is discharged into the cerebro spinal fluid. Post pituitary extracts if injected into mammals produce three important groups of actions namely the pressor (cardiovascular) action the oxytocic (uterine) action and the antidiuretic (renal) action. Experimentally

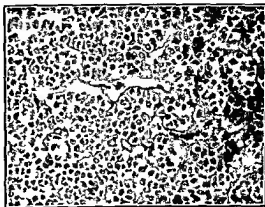


FIG 526 — MICROPHOTOGRAPH OF CHROMOPHOBIC ADENOMA OF THE PITUITARY (HIGH POWER)

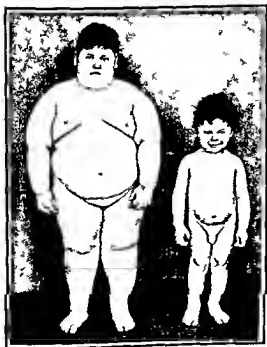


FIG 527 — THE TWO TYPES OF HYPOPITUITARISM IN CHILDREN

the removal of the posterior lobe leads to increased sugar tolerance adiposity and polyuria.

Tumours of the pituitary gland consist of adenomata and adenomatoma which are cystic tumours of Rathke's pouch. The commonest tumour of the pituitary is the adenoma which arises in the anterior lobe and is named according to the type of cell which it resembles.

(a) Chromophobe adenoma is the commonest type of pituitary tumour and it gives rise to hypopituitarism. It is composed of masses of non-granular cells showing no specific staining properties (Fig 526). Probably the cells are an embryonic type of the chromophobe cells which occur in the normal gland. There are

no eosinophile cells and the tumour does not furnish any endocrine secretion.

(b) Chromophile or eosinophilic adenoma is made up of granular

eosinophile cells that resemble the normal epithelium of the anterior lobe. The cells vary in size and shape and there are generally a few chromophobe cells present as well. This type of tumour produces symptoms of hyperpituitarism.

(c) Mixed adenomata resemble the general chromophobe tumour with some eosinophile cells scattered through it. These tumours give rise to dyspituitary or mixed syndromes owing to the blending of the hypo- and hyperpituitary features.

Hyperpituitarism is always associated with the anterior lobe and shows itself either as a gigantism in children or acromegaly in adults, the former being a relative increase of all parts of the body while in



FIG. 38.—SKELEGRAM OF SKULL, SHOWING ENLARGED PITUITARY FOSSA DUE TO AN ADENOMA OF THE PITUITARY (AFTER OPERATION)

the latter the chief changes are in the skull, spine and distal portions of the extremities. In hypopituitarism the effects also differ as they occur in childhood or adult life. When developed in childhood two types are noted: one in which the child is infantile in character with small bones and fine hairless skin (Lorain's disease); the other in which there is great and generalized deposition of subcutaneous fat with sex infantilism and increased sugar tolerance without any arrest in growth (Frohlich's syndrome) (Fig. 37).

Rathke's pouch or stalk tumours are wholly or partially cystic tumours arising in the pituitary stalk and are therefore supra-pituitary in position. These neoplasms are very similar in micro-

scopical appearance to fibrocystic disease of the jaw. It is for this reason that they have been named adamantinomas. One of the commonest characteristic features of these supra pituitary tumours is their tendency to undergo calcification which usually can easily be seen in skiagrams.

In all forms of pituitary enlargement signs of pressure may occur either early or late and the surgeon is then anxious to know whether the tumour is in the pituitary itself or is suprasellar in origin. If it is an adenoma of the pituitary, the sella turcica enlarges in size downwards and forwards (Fig 528), eventually depressing the sphenoidal air sinus, supra sellar tumours usually erode the clinoid processes, and there is flattening of the sella turcica. Varying disturbances of vision result from this, the most common being a bilateral hemianopia, followed in time by optic atrophy with complete blindness (Fig 529). Intracranial pressure is not markedly increased, but headache is often complained of usually without vomiting, and the sensation of the face may be impaired together with modifications of taste and smell.

It is only when pressure symptoms have arisen that operative treatment is indicated. There are two chief routes for exposing the pituitary gland (1) transfrontal and (2) transsphenoidal. The former is the one most usually adopted by neurological surgeons of this country.

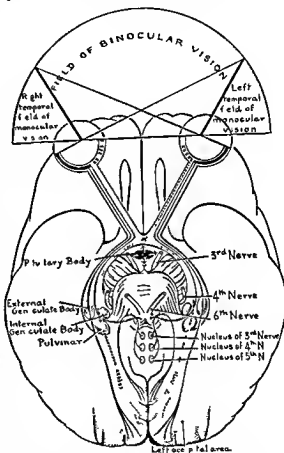


FIG 529—DIAGRAM SHOWING THE CONNECTIONS OF THE OPTIC NERVES TO THE OCCIPITAL CORTEX

The close connection of the pituitary and the optic chiasma can be seen

Transfrontal Exposure of Pituitary Tumours

The transfrontal approach should be used for all suprapituitary tumours



FIG 530 INCISION FOR TRANSFRONTAL APPROACH TO PITUITARY TUMOURS

of the sphenoid is reached (Fig 531). On the medial side the separation is limited by the olfactory groove. The dura mater is incised at the limit of separation and the cerebro-spinal fluid allowed to escape. An illuminated retractor is now inserted through the opening in the dura mater and beneath the frontal lobe of the brain and is then carefully and slowly retracted when the right optic nerve will gradually come into view (Fig 532). As a result of the pressure of the tumour the optic nerve may be flattened. The pituitary tumour will be seen to the inner side of the optic nerve and the internal carotid artery may sometimes be seen lying to the outer side of the optic nerve.

The patient should be placed in the supine position with the head slightly extended over a sandbag. An ear-to-ear incision is made starting about 2 cm above and in front of the ear and passing transversely across the head to the other side (Fig 530). The scalp is turned forwards over the face, the supra-orbital vessels and nerves being preserved. An osteoplastic flap is elevated outwards, the temporal muscle acting as a hinge (Fig 531). The next step is to elevate the dura mater from the orbital roof and keep it retracted by means of a retractor. The dura mater is gradually and very carefully separated by means of small rolls of cotton wool until the ridge of the lesser wing

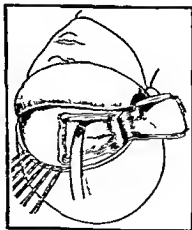


FIG 531—OSTEOPLASTIC FLAP RAISED AND THE DURA MATER EXPOSED

The capsule of the tumour is incised with the diathermy needle and the interior of the tumour is aspirated or removed by means of a small metal loop. The capsule is then gradually removed by careful traction. Haemorrhage may be controlled by means of small rolls of cotton wool and a gentle stream of hot saline solution. To be certain that all the tumour capsule is removed is wellnigh impossible in every case and for this reason it is advisable to give a course of X ray therapy after the operation.

Cystic stalk tumours are exposed in a similar way. The cyst is punctured, the fluid withdrawn and the capsule removed by firm traction. The closure of the wound after a transfrontal operation is quite simple. The bone flap is replaced, the periosteum sutured and the scalp returned and sutured with interrupted silkworm gut sutures.

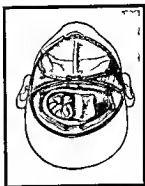


FIG 532 EXPOSURE OF BOTH FRONTAL LOBES BY A LARGE FLAP

Trans Sphenoidal Exposure of Pituitary Tumours

This operation is seldom performed to day its only indication is a case of acromegaly.

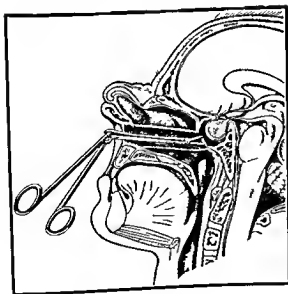


FIG 533—TRANS SPHENOIDAL EXPOSURE OF PITUITARY TUMOURS

Intratracheal anaesthesia is essential in this operation and the patient should be in the supine position with the head well extended. The frenum of the upper lip is incised and the lip retracted upwards with a periosteal elevator. The muco-periosteum is then displaced upwards until the anterior edges of the nasal septum are exposed. A submucous resection of the nasal septum is now performed and the sphenoidal attachment of the vomer exposed and removed. By means of a lighted speculum the anterior walls of

the sphenoidal sinuses can be seen and the thin bone which constitutes these walls together with the thin vertical septum separating

the two sinuses can then be removed by long thin alligator forceps thus exposing fully the cavity of the sphenoidal sinuses (Fig 533). The bulging floor of the sella turcica which forms the roof of the sphenoidal sinuses can now be seen and this is broken through exposing the dura mater covering the tumour. The dura mater is incised with a long thin hooked knife and the tumour contents can be seen discharging into the cavity of the sphenoidal sinuses. As much as possible of the softish tumour substance is removed by suction.

Drainage is carried out by inserting a thin strip of rubber into the sella turcica and allowing it to lie between the muco-periosteal layers



FIG 534 — ARTERIOGRAM IN A CASE OF PARIETO-TEMPORAL GLIOMA.

The cerebral vessels are pushed up by the tumour

of the nasal septum and fixing it to the frenum of the lip. The rubber strip should be removed after an interval of thirty-six hours. The nasal cavities are plugged with gauze soaked in vaseline which should be removed twenty-four hours after operation. The patient is nursed in the Fowler position.

The surgical treatment of pituitary tumours gives excellent results.

X-ray treatment of pituitary tumours should always follow surgical removal so that there is no fear of any recurrence. But X-ray treatment should never be given by itself in the absence of

operation where there are signs of increased intracranial pressure because there is a great tendency for the pressure to be raised still further owing to the oedema of the brain caused by the treatment. We have seen two fatal results follow such treatment and several cases of retinal haemorrhage.

Arterial encephalography may be of use in some cases where the diagnosis of the cerebral tumour is difficult. 10 to 20 c.c. of thorotrast are injected into the internal carotid artery and an X-ray exposure made. The outline of the cerebral vessels is clearly demonstrated (Fig 534). If a tumour is pressing on the brain that area will not appear to have any blood vessels passing to it. Arteriograms may also be useful in the diagnosis of congenital intracranial aneurysms and angiomas.

The Surgical Treatment of Epilepsy.

The only operative treatment for this condition now seriously considered is directed to the cerebral cortex, a proceeding dependent on the supposition that the epileptic convulsion results from an irritable condition of the cortex, which may be excited into convulsive activity by various stimuli, originating either in the brain or elsewhere.

When due to tumours, abscess, etc., epilepsy is accompanied by other manifestations which should guide the surgeon to a correct opinion as to the nature of the case and the operative outlook.

Traumatic Epilepsy is the term applied to an epileptic condition resulting from injuries. It may arise from any of the following conditions: (1) A neuralgic cicatrix in the scalp, (2) a slight unrelieved depression of the skull, (3) excessive formation of callus after a fissured fracture, or chronic thickening of the bone from osteitis after a contusion, whereby the dura mater is pressed upon and irritated, (4) chronic meningitis, usually associated with an adherent cicatrix in the brain, and particularly liable to occur in syphilitic patients, (5) a single depressed spicule of bone projecting into the cerebral substance, and (6) as a result of penetrating wounds of the brain which have been treated by decompression.

The Symptoms produced are epileptic seizures of the Jacksonian type, the exact manifestations varying with the portion of cerebral cortex which is involved. Localization of the lesion depends partly on the character of the aura, partly on the associated symptoms, such as a fixed headache or the presence of a cicatrix. The convulsions are localized to begin with but often become general.

Operative Treatment is only applicable in those cases in which the convulsions remain localized, general convulsions place the patient in the category of idiopathic epileptics with a focal onset. The skull is opened over the site of the supposed injury, and it may be that some depressed fragment or spicule of bone is found, it will, of course, be removed. Occasionally a cyst may be found, due to the presence of a hæmatoma at the site of an old injury. If, however, nothing is found but an adherent cicatrix between the membranes and the underlying brain, it is still an open question as to whether the surgeon should proceed further. In a considerable number of cases the cicatrix and underlying brain substance have been removed, the fits ceased for a time, but in most instances recurrence followed sooner or later from the formation of a fresh adherent cicatrix.

Hernia Cerebri.

By *hernia cerebri* is meant a protrusion of the brain substance through an *acquired* opening in the skull. It thus differs from an *encephalocele*, which consists in the protrusion of brain substance through some *congenital* defect.

It is always an evidence of increased intracranial pressure, and may be looked upon as Nature's safety valve for the relief of compression. It is met with in two distinct forms.

1 When a decompression operation has been performed for a cerebral tumour The brain substance protrudes through the opening under the scalp and by this means a temporary relief of intracranial tension is brought about the patient's life prolonged and possibly consciousness restored for a time. The tumour however continues growing and sooner or later the patient dies comatose unless the tumour is inflammatory and disappears

2 The other variety due to a compound depressed or punctured fracture is the result of infection in the underlying brain substance and the increased pressure within the skull thereby induced leads to a protrusion of inflamed and oedematous cerebral tissue through the wound in the dura which is usually of small size. The tumour is soft and dusky in colour and pulsates synchronously with the heart the pulsations being often evident to the naked eye and it usually increases in size somewhat rapidly. At first the mental condition of the patient is unimpaired but sooner or later coma follows if the hernia progresses ending in the patient's death. To begin with the mass consists mainly of oedematous granulation tissue covered by blood-clot without much brain substance but later on cerebral tissue itself may protrude. The condition is usually recovered from with care but the patient has an adherent cicatrix and is always liable to develop evidences of cerebral instability epilepsy or insanity. In spite of this he may remain fairly well if the original hernia did not involve the lateral ventricle if this cavity or any of its prolongations is laid open and invaded by sepsis inflammatory troubles are certain to supervene without much delay in spite of temporary healing. Within two years all such patients are likely to die of septic encephalitis.

Treatment.—Prevention of this affection must always be aimed at by endeavouring to render any wound involving the meninges aseptic and providing for relief of tension. Punctured wounds and depressed fractures of the skull even when giving rise to no urgent symptoms should always be operated upon since freedom from tension may prevent the formation of a hernia cerebri even should absolute asepsis not be attained. If however a hernia has developed treatment consists in the application of wet gauze packs soaked in hypertonic saline solution or in glycerine and formalin (2 per cent) with the object of providing an escape for the fluid from the oedematous hernia dry dressings are always undesirable. Gentle pressure is useful and lumbar puncture is sometimes helpful. Under no circumstances should any attempt be made to slice away the mass. After a time and sometimes quite suddenly the condition begins to improve the hernia diminishes in size and the wound granulates over and heals leaving however an adherent cicatrix.

CHAPTER XXX

AFFECTIONS OF THE LIPS AND JAWS

Affections of the Lips

Hare-Lip—By hare lip is meant a congenital fissure of the upper lip which may extend for a variable distance through the soft tissues



FIG 535—SINGLE HARE LIP WITH BUT LITTLE INVOLVEMENT OF THE ALVEOLUS AND HENCE SLIGHT DEFORMITY OF NOSE



FIG 536—SINGLE HARE LIP AND COMPLETE CLEFT OF ALVEOLUS AND PALATE WITH GREAT NASAL DEFORMITY

alone or may also implicate the bony alveolus and the floor of the nose and extend backwards through the palate. The name is not



A



B

FIG 537—DOUBLE COMPLETE HARE LIP WITH DISPLACEMENT FORWARDS OF THE CENTRAL PORTION OF THE INTERMAXILLA (OS INCISIVUM)

A Front view B seen in profile

a good one since a hare's lip is cleft in a Y shaped manner the fissure being central below and bifurcating above into each nostril

Varieties—A hare-lip is *complete* or *incomplete* according to whether or not it extends into the nostril. It is termed *simple* (Fig 535) if limited to the soft parts *alveolar* if the bony alveolus is also involved *complicated* if associated with a cleft palate (Fig 536). The defect may exist on one or both sides of the middle line if *unilateral* or single it is most common on the left side in the proportion of two to one if double or *bilateral* it is usually but not invariably alveolar and accompanied by a complete cleft of the palate. The central portions of the lip and alveolus (os incisivum) may retain either their normal position or as is more frequently the case in the bilateral type project

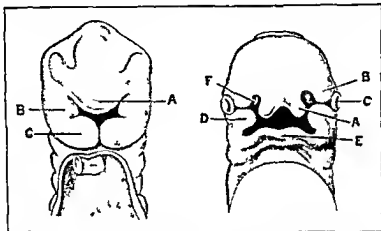


FIG 538—HEAD OF FŒTUS OF ABOUT FIVE WEEKS FROM VENTRAL ASPECT (AFTER HIS) SHOWING THE PRIMITIVE STOMODEUM BOUNDED ABOVE BY (A) THE UNDIVIDED FRONTO-NASAL PROCESS Laterally BY (B) THE MAXILLARY AND BELOW BY (C) THE STILL SEPARATE MAXILLAR PROCESSES.

The quincunx-like appearance is well represented

FIG 539 HEAD OF FŒTUS OF SIX TO SEVEN WEEKS FROM THE VENTRAL ASPECT (AFTER HIS)

The mandibular processes (E) have now united the ocular vesicle (C) is seen on either side towards the upper end of the orb-to-nasal fissure and the fronto-nasal process has developed (A) internal and (B) external nasal processes on either side of (F) the still unclosed anterior nares (D) maxillary process.

forwards at the end of the nose forming a proboscis-like appendage (Fig 537 A and B) its base of support is often thin and elongated so that lateral mobility may be obtained. Even in simple cases the nose is deformed being broad and flattened a condition which becomes much more marked when the alveolus and floor of the nose are widely fissured. Hare-lip is not uncommonly associated with other deformities e.g. spina bifida and talipes and it is frequently transmitted from one generation to another. Occasionally a thin red line as of a cicatrix is seen occupying the position of a hare-lip cleft and is probably due to a persistence of the raphe of union of the labial segments a slight

groove in the alveolus may also be observed at a corresponding point

Development—The bony and fleshy parts of the face originate from the outgrowth of processes around the cavity formed by the bending forward of the primitive cerebral vesicle over the end of the notochord. At about five weeks after conception the primitive buccal cavity or stomodæum has a quinque-radiate appearance due to the manner in which these processes are formed (Fig 538). A broad median lappet (fronto nasal process, A) descends from above, this is separated by a fissure on each side from the symmetrically placed maxillary processes (B), and these again below from the more prominent mandibular processes (C), which early unite across the middle line, to form the lower jaw. The fronto nasal process soon, however, changes. On either side of a slight depression in the median line is placed the internal nasal process or globular process (Fig 539 A), from which are produced superficially the central portion of the upper lip and from its deeper aspect the intermaxilla which divides into the two incisive segments, each carrying the germ of an incisor tooth. Separated from this by a hollow (F), which subsequently forms the anterior nares is the rounded external nasal process (B) from which develop the side of the cheek and the ala nasi. External to this a fissure (naso orbital) runs up to, and even beyond, the primitive eye (C) and this is later on closed by amalgamation of the internal and external nasal processes on the inner side with the adjacent maxillary process on the outer (D) except in the deepest part, which constitutes the nasal duct. The integrity of the upper lip is obtained by the union of the lower parts of the internal nasal and maxillary processes, which thus exclude the external nasal from participation in its free border. It is doubtless owing to this arrangement that the sulcus or depression around the ala nasi constitutes such a distinct and characteristic feature of the face. At the same time the deeper parts of these nasal processes are uniting with one another and with the palatal plates which grow horizontally inwards from the under side of the maxillary processes uniting in a Y shaped suture the point of junction of the limbs being situated at the anterior palatine canal. The union of all these elements is taking place from the sixth to the tenth week, and by that date even the uvula the last part to unite should be complete.

Ordinary hare lip is due to a failure of union of the internal nasal process with the structures in external relation with it, if limited to the soft parts (simple hare lip) the cleft runs between the internal nasal and maxillary processes if complete or alveolar, between the same two below and superficially, but in addition between the internal and external nasal processes above and on the deep side. The cleft in the alveolus passes between the intermaxilla and the maxilla (Fig 540). The relation of the cleft to the teeth varies somewhat, since the germ of the lateral incisor may be developed on one or other side of the suture between the maxilla and intermaxilla, or may even lie between the segments. Hence the lateral incisor is sometimes found on the outer side of the cleft sometimes on the inner, moreover, an accessory incisor is occasionally developed on the inner side of the cleft.

The os incisivum or projecting portion of the intermaxilla usually consists of two segments of bone united in the median line and in a child most frequently contains only the two milk central incisors and the rudiments of the two permanent ones occasionally as we have just stated there may be an extra tooth developed on one or both sides of the process

A simple hare-lip does not interfere seriously with the infant's nutrition but when double and especially if associated with a cleft palate considerable trouble may arise thus necessitating surgical treatment as a life saving measure at a very early date. It must also be remembered that all movements of the face *e.g.* in crying or laughing exaggerate the deformity from the unbalanced action of the divided orbicularis oris and other muscles

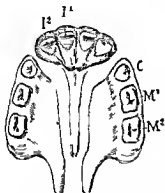
As to the *period* at which to operate the sooner the better during the first week of life is the usual time as this allows the infant to take the breast or feed from a bottle in a normal manner

Operation for Single Hare-Lip—The child should be laid on an operating table with its arms bound to the body. The surgeon stands behind it the anæsthetist and assistant one on each side. The operation may be described in three stages

1 The lip is thoroughly dissected up from the maxilla and alveoli by cutting through the reflections of mucous membrane and the attachment of the muscles and other soft parts. This is mainly needed on the outer side and where there is much flattening of the nose the ala nasi will also require to be separated

FIG 540 DIAGRAM TO REPRESENT THE SITUATION OF THE CLEFT IN ALVEOLAR HARE LIP

I I¹ Incisors C canine tooth
M¹ M² first and second molars



ated. This may cause some amount of bleeding but sponge pressure easily controls it

2 The edges of the cleft are then pared. The object to be attained is the union of the cleft lip by means of a cicatrix which shall be as unobtrusive as possible whilst the red margin must be continuous and the section such that the raw surfaces are larger than are absolutely necessary so as to allow for subsequent cicatricial contraction without the development of a notch. Two of the best methods are as follows

(a) The incision extends from the apex of the cleft or from within the nostril in a crescentic manner (Fig 541) on each side and where the nose is much flattened more tissue is removed on the outer than on the inner so that when the parts are sutured together the nostrils become as nearly as possible symmetrical. By this means the depth of the lip is increased to allow of subsequent contraction whilst the red margin can be made continuous

(b) *Mirault's Operation* (Fig 542)—The inner margin and apex of the cleft are pared so as to leave a raw surface a flap of red marginal tissue as thick as possible is then cut from the outer side and implanted on the bevelled raw surface of the red margin on the inner side the upper portions of the cleft being also apposed

3 Sutures are now inserted to maintain the lip in the position into which it can be drawn by the fingers without tension Two deep



FIG 541—ROSE'S OPERATION FOR SINGLE HARE LIP

On the left side the semilunar incisions are seen extending as far as the free borders of the lip The right hand figure shows the parts drawn into position the cross lines represent the catgut or horsehair stitches

silver wire sutures should be introduced one just above the red margin and one close to the nose to draw into position and steady the nostril which should be left smaller than that on the other side so as to allow for subsequent dilatation which is certain to occur Horsehair or catgut stitches are used to bring the exact margins together the continuity of the muco cutaneous line being accurately preserved



FIG 542—MIRAULT'S OPERATION FOR HARE LIP

The formation of the prolabial flap is shown ready to be implanted on the prepared inner side

and the cut edges of the mucous membrane upon the deeper aspect being sutured each stitch after it is tightened being used to elevate and evert the lip and thus assist the insertion of the next The wound is dressed with a small piece of gauze and secured by another dry piece cut in the shape of a butterfly so that the narrow body shall fit over the lip and the wings spread over the cheeks this is fixed by collodion and maintained for some days after the stitches are removed

the deep ones on the fourth day and the superficial ones about the eighth or tenth. Careful feeding by spoon is necessary, the mother's milk being drawn off and given in this way if possible. In simple cases the child may be returned to the breast about the fifth day. In order to prevent the child from picking at the lip or disturbing the dressing it is well to put a splint on the flexor side of each arm to control the elbow joint.

The Treatment of Double Hare-lip may be discussed under two headings: viz the treatment of the os incisivum and that of the soft parts.

The os incisivum need not be touched if it retains its normal position and the labial clefts are then alone dealt with, but if it projects forwards as is often the case it must be either removed, replaced, or reduced in size. (a) In bad cases where there is much projection the process must be removed. The central portion of the upper lip is freed from it by dissection and the base of the process divided with cutting pliers: a small artery in the bone will spurt vigorously, and may need



FIG. 343.—ROSE'S OPERATION FOR DOUBLE HARE LIP.

The central tubercle is pared in a V-shaped manner and the lateral segments by curved incisions extending to the red margin and then inwards. Only the apex of the central portion is included in the completed lip.

an application of the cautery to stop it. The operation on the lip is deferred till ten days later. A certain amount of deformity from dropping back of the upper lip is certain to result but can be in measure obviated by adding a projecting cheek plate to that which carries the artificial incisors. (b) Reposition may be effected by several methods the best of which is Bardeleben's who incises the lower border of the septum, strips off the muco-periosteum from either side and then bends or breaks the bone back into position, fixing it by silver wires and uniting the lip at once to form a splint to maintain it *in situ*. The advantages claimed for reposition are that the patient retains his own central incisor teeth and that the normal contour of the jaw and face is not interfered with. Against this plan however must be placed the facts that the bone rarely becomes firmly united, that the teeth are stunted and erupt obliquely backwards from rotation of the process and that its presence prevents the maxillae from falling together and increases the difficulties of subsequently closing the palatal cleft. By dividing the septum parallel to the plane of the palate the process

can be slid back and its rotation is thereby avoided (c) Where however the projection is not great the size of the os incisivum can be lessened by gouging out the teeth contained within it so that the lip can be closed over it

The soft parts of the lip are dealt with in much the same way as in single hare lip. They are freely detached from the maxillæ and the edges pared as shown in Fig 543 the central portion being cut into a V and no attempt made to incorporate it into the free margin for

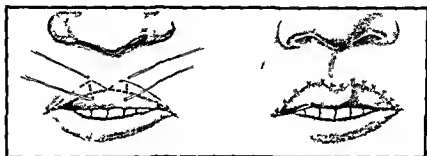


FIG 544 —GILLIES OPERATION FOR THE FORMATION OF CUPID'S BOW

fear of depressing the tip of the nose whilst the lateral segments are pared as in the single operation. These latter are now drawn together and united in the middle line below the central portion so that a Y shaped cicatrix results. One of the stitches should fix the apex of the V the other should be inserted just above the red margin. The dressing and after treatment are as in the single operation. For a time the child may have difficulty in breathing owing to the diminution in the size of the oral aperture but this is obviated by the nurse drawing down the lower lip with the fingers.

Although this operation gives excellent results the upper lip is often straight with very little mucous membrane showing. In these cases the Cupid's bow operation devised by Gillies gives excellent results as can be seen in Fig 544. This operation is performed some ten years or more after the original one.



FIG. 545 —MEDIAN HARE LIP

Median Hare-lip may occur in one of two forms either a simple cleft exists in the middle line (Fig 545) or there may be an absence of the inter maxilla and nasal septum causing flattening of the bridge of the nose and a broad median defect flanked by the maxillary portions of the lip.

Oblique Facial Cleft is an uncommon deformity characterized by a cleft or sulcus in the face starting from the usual situation of a hare-lip below but running up outside the nostril to the inner side of the lower lid (Fig 546). Coloboma of the iris or choroid is sometimes associated with this rare defect. The deformity is due to non closure

of the naso-orbital fissure and runs along the line of the nasal duct. It may be limited to the soft parts or may involve the bones even laying open the antrum.

Macrostoma (Fig 547) is characterized by an abnormal width of the mouth and is due to non union of the maxillary and mandibular processes. It may be uni or bi lateral and is usually associated with anomalies of development of the ear accessory auricles being often present. As a rule a small papilla on the upper and lower margins will indicate the true limits of the mouth being constituted by the points of attachment of the orbicularis. The existence of these is of great importance as indicating the extent to which the cleft must be pared in order to restore the mouth to its normal size.

Mandibular Clefts are exceedingly rare. They are due to non union



FIG 546—OBLIQUE FACIAL CLEFT OR RATHER CICATRICAL DEFORMITY ALONG THE LINE USUALLY TRAVERSED BY SUCH A CLEFT



FIG 547—MACROSTOMA WITH AURICULAR APPENDAGES.

of the mandibular processes in the middle line and involve either the soft tissues of the lower lip alone or may extend to the bone and even the tongue. Treatment is as for ordinary hare-lip.

Microstoma is the term applied to a condition in which the fusion of the parts entering into the formation of the lips progresses to a greater extent than usual so that the oral orifice is contracted. It may be associated with defective development of the lower jaw. In the more severe cases where the mouth is extremely narrowed a transverse cut should be made outwards on each side and the mucous membrane stitched to the skin.

Macrocheilia, or hypertrophy of the lip occurs in three forms (1) The congenital variety a condition analogous to macroglossia and due to a congenital distension of the lymphatic spaces or chronic lymphangiectasis accompanied by overgrowth of the connective tissue

The lower lip is most often involved and is firm thickened and everted causing considerable deformity. The treatment consists in the removal of a V shaped portion from the centre. (2) An acquired form occurs in children and young people with a tuberculous inheritance constituting the so-called strumous lip. Either lip may be affected but perhaps more frequently the upper. The thickening is due to a chronic lymphangitis resulting from the absorption of toxic material from persistent cracks and fissures. If these can be healed and the general health improved diminution in the size of the lip soon follows. (3) In adults macrocheilia is in almost all cases due to tertiary syphilis. The lower lip is most often enlarged and becomes thick and hard. It is due to the diffuse sclerosis characteristic of tertiary mischief. General treatment and not local is needed.

Syphilitic Affections of the lip are not uncommon. A primary



FIG 548 — CHANCER OF UPPER LIP

The enlargement of the submaxillary lymphatic glands is very evident



FIG 549 — CHANCER OF LOWER LIP

The submaxillary lymphatic glands are enlarged

chancre may be caused by kissing or by smoking an infected pipe or drinking from a glass with an infected rim. It usually presents a smooth ulcerated surface discharging a small amount of sero pus resting on a mass of infiltrated tissue which may extend over the whole lip (Fig 548). The induration is not so great as in chancres upon the genital organs but the infiltration is much more extensive. Enlargement of the submaxillary lymphatic glands occurs very early and the disease usually runs an active course. A labial chancre may closely resemble epithelioma but is distinguished from it by its rapid development up to a certain point by the early implication of the glands which soon become very large by the positive Wassermann reaction by the age of the patient and the course taken by the case as well as by the local appearances (Fig 549). The surface is usually flattened and less warty and irregular than in epithelioma whilst the skin is

more involved than the mucous membrane. Moreover it is more common on the upper lip whilst epithelioma is usually seen on the lower (compare Figs 550 and 551). In the *secondary* stage mucous tubercles are frequently met with involving the inner side of the lip and the angle of the mouth. In the *tertiary* period serpiginous ulceration and gummata may occur or the diffuse induration described above. In *inherited* syphilis cracks and mucous tubercles are constantly present and may be so extensive as to leave cicatrices radiating from the mouth which are very characteristic (Fig 49 p 176).

Cracked Lips (or as they are often called *chapped lips*) are usually the result of cold weather a central crack or fissure forming which is extremely painful and liable to bleed very readily on evertng or stretching the part. The lower lip is that generally affected. In tuberculous children more than one may occur and by their persistence they give rise to a considerable degree of induration and infiltration and perhaps lead to glandular trouble. All that is needed in the shape of *treatment* is the application of a little lanoline or cold cream but



FIG 550—CHRONIC EPITHELIOMA OF LOWER LIP



FIG 551—EPITHELIOMA OF ANGLE OF MOUTH INVOLVING BOTH LIPS

if they persist it may be advisable to touch them with nitrate of silver.

Herpes Labialis is a condition usually associated with catarrh and not unfrequently with pneumonia or other fevers. Either lip may be affected and the herpetic eruption is quite limited in extent. It consists of a number of little vesicles situated on a hyperæmic and painful base after a few days the vesicles become transformed into pustules and these in turn burst and dry up the whole affection lasting perhaps a week or ten days. No special treatment is required. If the inner aspect of the lip is affected the epithelium early becomes sodden and is shed so that the vesicular stage is much shorter.

Mucous Cysts occur on the inner side of the lip in the form of small rounded swellings which are translucent and contain a glairy fluid. They are often due to trauma whereby the opening of a mucous gland is blocked. The whole cyst wall should be dissected out and the wound closed by stitches.

Nævi are frequently met with in the lip. If confined to the inner aspect they may be dissected out but when large and involving the whole thickness they should be dealt with by electrolysis.

Warty Growths are often seen on the lower lip, especially near the angle, and may then simulate epithelioma. They are distinguished, however, by the fact that ulceration is not often present, that the lymphatic glands are not involved, and that there is but little infiltration of the base (Fig 552). They should, however, be removed as early as possible, since malignant disease often starts from them.

Epithelioma of the lip usually occurs in men of the working classes, and is commonly due to the irritation produced by smoking a short clay pipe, which is allowed to rest on one or the other side near the angle. A semicircular notch will frequently be noticed in the teeth of the upper and lower jaw, corresponding to the situation of the growth on the lip, and caused by the constant friction of the pipe stem. It may also start opposite the site of some projecting rough or carious tooth. It is but rarely met with in women, occurring in England in not more than 5 to 6 per cent. of the cases and probably most of these are clay pipe smokers. It is certainly more common amongst country folk, who use the short clay pipe, than amongst the cigarette and cigar smokers in towns.

The disease may start as an induration around a crack or fissure, which gradually extends, forming a typical malignant ulcer, or as a wart-like growth, which fungates and ulcerates, or as a chronic infiltration leading to an irregular nodulated thickening of the lip, which sometimes looks shrunken and feels sclerosed (Fig 550). Occasionally it develops at the angle of the mouth, and then involves both lips (Fig 551).

Unchecked by treatment, the disease steadily progresses, forming an ulcerated mass of greater or less size, and even involves the jaw. The submental and submaxillary glands are early implicated as also the glands which accompany the carotid vessels. Beyond this however, the disease rarely extends, visceral complications being uncommon. Death is generally caused by the secondary growths in the neck, which attain considerable dimensions and then ulcerate, this stage being possibly preceded by one of cystic degeneration. From these ulcerating surfaces a quantity of discharge escapes, the amount varying with the septicity or not of the wounds. Intense pain is caused by implication of nerves, and hæmorrhage from the vessels in the neck is likely to follow.

The **Diagnosis** of epithelioma is rarely doubtful, but occasionally warty growths or even a primary chancre, may be mistaken for it. The clinical history generally suffices to determine the nature of the mass, as also the character of the base and the appearance of the parts, but in uncertain cases the removal of a small portion of the edge under local anæsthesia, and its microscopic examination are required to set doubts at rest.

Treatment—The primary growth must be excised completely, if



FIG 552.—PAPILLOMA OF UPPER LIP

such be possible together with its lymphatic connections including the submental and submaxillary glands and the deep carotid glands whether they can be felt enlarged or not. When once the deeper glands in the neck have become palpably enlarged they often contract such adhesions as to render their extirpation impracticable.

If the growth is limited to one part of the lip incisions extending half an inch beyond it in all directions should be made (Fig 553) and the wound closed as in a case of hare lip without much deformity resulting. When it is more extensive considerable ingenuity must be exercised in order to make good the defect.

When the whole lower lip requires removal *Synce's operation* may be performed with advantage. It consists first of all in the complete excision of the diseased lip. Two curved incisions are then made starting from the middle line of the wound and extending downwards under the chin to terminate below the angles of the jaw an inverted V shaped portion of skin between them remaining fixed to the symphysis menti to form a base of support for the new lip. The lateral



FIG 553—INCISIONS FOR REMOVAL OF EPITHELIOMA OF LIP

flaps are now dissected up raised and united one to the other in the middle line so as to constitute the new lip an inverted Y shaped cicatrix resulting. The elasticity of the skin in this region allows this to be accomplished and the whole wound closed without leaving any part to granulate. The mucous membrane should be finally stitched to the skin over the upper free margin. Healing by first intention usually follows.

If the whole of the upper lip needs to be removed it may be restored in a variety

of ways. Perhaps one of the best consists in making incisions which skirt the alae nasi on each side and then extend outwards into the cheeks sufficiently to allow the tissues when they have been freed from the maxilla by undercutting to be drawn together in the middle line. In such cases care must be taken not to encroach on Stenson's duct.

Radium may be used instead of operation and should always be tried in inoperable cases. It is important to protect the teeth and the jaw by sheets of lead otherwise necrosis will supervene. Interstitial radiation is essential surface application is useless. The total dose will vary with the size of the growth and will consist of from 1500 to 3000 mg. hours. The glands in the neck can be treated in a similar manner.

Affections of the Teeth

Dental Sepsis—Allusion has already been made (p 65) to the important part played by this condition in the production of many forms of general poisoning of the system of the so-called rheumatic type and in the genesis of various inflammatory conditions of the intestinal track and its adnexa. Streptococci are normal inhabitants of the mouth, and these, together with various diphtheroids, are probably responsible for most of these lesions. Staphylococci are not often present. Doctors and dentists must co-operate in dealing with these affections, which play such an important part in the health of the community.

There are two main sources of absorption in connection with the teeth, viz the apices and the gums.

1. Peri-apical infections occur in about half the cases. The sequence of events is usually as follows. The pulp cavity of the tooth becomes infected as a result of the extension of dental caries from the surface, acute inflammatory phenomena of a purulent type, accompanied by severe toothache, end in necrosis of the pulp, and when effective drainage is not provided, in escape of bacteria through the apical foramen. Inflammation is hereby caused, and may result in the formation of a gumboil (Fig 555), with relief to the pain and tension. If no gumboil forms, the process may quiet down, but an encapsulated focus remains at the apex of the tooth. If the peri-apical trouble is chronic from the first, a granulomatous nodule forms, or a small cavity lined with granulation tissue results, or the bone itself is invaded, and possibly a localized necrosis follows. From any of these local lesions general absorption may occur. The affected tooth may or may not be tender on pressure, the pulp cavity may have been filled, and yet mischief may be present, as some tiny septic focus near the apex may have been overlooked, and thus the filling may have done harm rather than good.



FIG 554—SKIAGRAM SHOWING APICAL ABSCESSES IN CONNECTION WITH TEETH

X-ray examination in all such cases is an essential element in diagnosis, and the interpretation of such radiographs by an expert is very necessary, since many pitfalls exist for the inexperienced (Fig 554). A definite cavity or focus of necrosis around the apex of a tooth is fairly easy to recognize, but the mere existence of alveolar absorption around teeth, especially in those past middle life, must not be looked on as necessarily dangerous or requiring extraction.

The wholesale removal of teeth for chronic rheumatism in the hope of thereby eliminating some undiscovered focus of septic absorption is wholly unjustified, and has been carried to such length as to be a disgrace to the profession. Each tooth should be separately

is absorbed parchment like cracking can be felt finally the condition presents as a rounded tense elastic swelling around the margins of which the remains of the expanded bone can be detected. In the upper jaw they often encroach on and project into the bony antral cavity pushing the mucous membrane in front of it. The tooth which is the cause of the trouble is always dead and frequently merely a septic root is present.

The *cause* of these cysts is probably the proliferation of certain embryonic remains of the enamel organ brought about by the irritation of toxic matter which has escaped from the pulp cavity. These fetal residues are lighted up into activity developing into masses or columns of epithelial tissue which undergo cystic degeneration. Their pathogenesis is practically identical with that of the epithelial odontome (p. 209) but merely one cyst develops here instead of many. The fluid contained therein is thick and mucoid in character and

broken down epithelial cells and cholesterol are seen in it on microscopical examination.

Treatment.—The cyst must be laid freely open into the mouth the septic tooth or stump removed, and the anterior wall of its alveolus cut away. The alveolus and cyst thus laid into one cavity are scraped so as to remove all the epithelial lining and packed with gauze so as to ensure healing by granulation.



FIG. 356. LARGE DENTAL CYST IN LOWER JAW.

In the upper jaw the utmost gentleness is required in dealing with the deeper wall of the cyst as the septum between it and the antral cavity may be extremely thin and entirely devoid of bony tissue.

Odontomata or tumours connected with the teeth are described elsewhere (p. 209).

The Extraction of Teeth.—Although this operation is usually undertaken by dentists yet surgeons and medical practitioners have not unfrequently to perform it and not a little skill and judgment are sometimes needed in its execution. An anæsthetic may or may not be employed. If merely one or two teeth are to be drawn gas or chloride of ethyl will suffice but when a large number require extraction at one sitting it is better to give ether or the C.E. mixture chloroform should never be administered when the patient is in the sitting position. The posterior teeth are of course dealt with first and subsequently those in front. Suitable forceps are required for the various teeth and the number of fangs belonging to each must be kept in mind. Incisor and canine teeth are removed by a combination of traction and

rotation, the bicusps and molars by traction combined with lateral movement, especially inwards. The forceps, after being sterilized, should be pushed well up under the gum, and no traction made until a firm grasp has been taken of the neck of the tooth and the tooth itself loosened by lateral swaying.

Accidents of various types happen from time to time. The crown may break away, leaving the fangs *in situ* and then each of these must be sought with root forceps and accounted for. In dealing with the first or second upper molar, it is quite possible to drive a fang upwards into the antral cavity, setting up thereby acute suppuration within the cavity. Laceration of the gum is often unavoidable, and injury to the alveolar margin may follow, but such accidents as fracture or dislocation of the lower jaw are certainly avoidable. The use of an elevator is sometimes desirable in order to remove old roots, but it is an instrument that must be used with great care.

After extraction the mouth is washed out with sterilized or carbolized water, and the bleeding usually ceases without delay. If the gum has been much torn, it should be pressed back into position by the fingers, and when the mouth is dirty it may be desirable to touch the socket over with tincture of iodine. A mouth wash of boric acid or sanitas is subsequently employed.

Should the *hæmorrhage* continue as in patients suffering from purpura, scurvy and hæmophilia, the socket must be carefully plugged with a strip of gauze soaked in a styptic such as adrenalin or hæmoplastin, the use of perchloride of iron in this connection is undesirable. Occasionally the bleeding restarts after two or three days as a result of infection of the socket, it is then necessary to open up the cavity freely from the outer side, cutting away gum and, if need be, bone, so as to allow free exit to discharges and a more ready access for strips of gauze soaked in styptics or antiseptics.

Wisdom Teeth are not an uncommon source of trouble, mainly by their abnormal eruption, both as to date and manner, and this chiefly owing to the reduction in the size of the jaws brought about by civilization. The most common condition is for the wisdom tooth to be wedged against the second molar in such a position that its eruption is impossible. Inflammatory phenomena usually follow, or trismus, and it becomes essential to relieve the condition. The offending tooth is generally so deeply buried that even under a general anæsthetic it is almost impossible to reach it, and the better treatment is to remove the second molar, when normal eruption may quickly follow, and the wisdom may be able to take on the work of the second molar. In other less common cases the wisdom tooth does not erupt, but remains buried even when the second molar has been previously removed. If it should come to the surface sufficiently to cause an opening in the gum, infection may occur and the removal of the offending tooth becomes essential. This may be very difficult, as it is often buried deeply and in part covered by the gum tissues. A sufficient opening in the gum must then be made, if necessary by cutting it away, so that the crown can be clearly seen. If forceps or elevator fail to effect its removal (and it is often very firmly fixed in the bone), it may be

desirable to burr away the surrounding bone so as to set the tooth free. The greatest care must be taken to prevent infection of the surrounding tissues or serious consequences may follow.

Affections of the Gums and Alveolar Processes

Spongy or Inflamed Gums (gingivitis) are not unfrequently caused by a dirty and uncared for condition of the teeth the administration of mercury or scurvy.

Pyorrhœa Alveolaris (or Riggs' Disease) consists in an inflammatory condition of the margins of the gums accompanied by a purulent discharge which arises from pockets or pouches which may extend a greater or less distance along the roots of the teeth. In the worst cases the gums are swollen and oedematous to such an extent that they often hide or partially cover the stumps of decayed teeth and they bleed readily. The tongue is coated and the breath exceedingly offensive. In less severe cases and in the later stages the tissues of the gums shrink and together with the alveolar border become atrophic the fangs are thereby uncovered and the teeth loosened so that after a while a natural cure may be established by the patient becoming edentulous. The process is limited to a few teeth or may involve many. It is generally preceded by an excessive deposit of tartar beneath which bacterial infection occurs the inflammation spreading down along the periodontal membrane and perhaps extending to surrounding parts e.g. the maxillary antrum. In most cases on making pressure along the alveolar margins a greater or less quantity of pus can be squeezed out. For the constitutional results of this *oral sepsis* see p. 66.

Treatment must in the first place be directed to the teeth and consists in the removal of tartar and the application of astringents and antiseptics preferably peroxide of hydrogen not only to the exposed mucous membrane but also into the pouches and pockets where pus collects. In some cases it is wise to destroy the granulation tissue forming the outer wall of these pouches by means of the electric cautery or even to remove the teeth. Too much must not be done at a time as the general symptoms may be aggravated by an increased absorption of toxins and the reparative activities of the patient may be very deficient. In resistant cases vaccine treatment may be desirable.

Hypertrophy of the Gums is met with in the form of a sessile overgrowth sometimes almost cauliflower like around and between the teeth which are usually carious. It occurs most frequently in children. In slight cases the overgrowth may be destroyed by the application of a crystal of trichloroacetic acid but in the more exaggerated types excision is required.

Epulis—By this term is meant a tumour growing from the alveolar periosteum. Two varieties are described viz. the simple and the myeloid.

A Simple Epulis is usually of a fibromatous nature and may grow from either jaw though more commonly from the lower. It is generally

due to the irritation of diseased teeth and although most marked on the outer aspect it burrows between the teeth and is also found on the inner side. It appears as a red fleshy mass smooth or perhaps lobulated (Fig 557) of an elastic consistency and possibly associated with a little superficial ulceration. It is covered with mucous membrane and may contain a few spicules of bone. The treatment consists in removing the growth together with the teeth or stumps with which it is connected. If small it will suffice to cut away and scrape the bone from which it arises but if large or if it recurs after such treatment the portion of the alveolus from which it springs must also be excised. This is best accomplished by extracting a tooth on either side of the tumour and cutting vertically through each socket with a saw the two incisions being united below by a chisel so as to remove a quadrangular portion of bone without interfering with the continuity of the jaw.

Myeloid Epulis—This title is applied to a myeloma developing from the interior of the alveolar process. It forms a soft rapidly increasing

mass of a dusky purple colour which runs on to ulceration or fungation the deeper portions may contain an ossific deposit. Treatment consists in free removal of the tumour and of the portion of alveolus from which it arises. In the upper jaw this sometimes necessitates excision of the complete palatal segment of the maxilla but in the lower jaw it is generally possible to maintain the continuity of the mandible by removing merely a quadrilateral portion in the same way as for a simple epulis. Operation should always be followed by irradiation.



FIG 557—SIMPLE EPULIS

Epithelioma and Sarcoma (round or spindle-celled) arising from the gum are both met with. Epithelioma in this situation occasionally fungates but more often invades the bony tissues and in the upper jaw extends upwards to the antrum hence it is sometimes termed a creeping or burrowing epithelioma. The ordinary signs of this disease become evident lymphatic glands are enlarged and typical ulceration of the gum follows. The only possible treatment consists in free excision of the growth together with the portion of bone affected and the lymphatic area involved.

Necrosis of the Jaw—Causes (1) Subperiosteal alveolar abscess connected with dental caries (2) Traumatism such as blows on the jaw with or without fracture in the latter instance being due to infective osteitis. The use of dirty forceps or elevators in extracting a tooth may similarly light up an infective inflammation, resulting

in necrosis (3) It may follow one of the exanthemata or any condition of malnutrition arising as an infective idiopathic or embolic osteomyelitis and then probably affecting a considerable extent of bony tissue possibly the whole mandible (4) It results from mercurial poisoning but rarely at the present day (5) Phosphorus necrosis is met with amongst those who work in lucifer match factories but only when ordinary phosphorus is used the amorphous form is harmless. The fumes are supposed to gain access to the jaws through carious teeth giving rise to a somewhat acute inflammation which terminates in necrosis. A considerable amount of new bone forms beneath the periosteum and the sequestrum which is curiously grey and porous like pumice-stone is always slow in separating. Either jaw may be affected but the lower a little more commonly than the upper (6) Tubercle and actinomycosis are occasionally responsible for this condition and in tertiary syphilis it is observed usually affecting the alveolar borders of the palate.

The Clinical Phenomena associated with necrosis of the jaw are necessarily much the same whatever the cause. The acute form commences with severe pain in and around the jaw followed by great swelling of the face and difficulty in opening the mouth or taking food. The temperature is raised and even rigors may be present the breath is usually foul. Sooner or later an abscess forms which may point either in the mouth or on the face or the pus may burrow downwards for some distance into the neck.

Treatment—In the early stage the cheek should be fomented but as soon as there is any suspicion of pus a free incision is made down to the bone inside the mouth and along the line of reflection of the mucous membrane. When necrosis is present it must be treated in the ordinary way the sinuses being flushed out with an antiseptic solution three or four times a day until the sequestrum is loose it is then removed if possible from within the mouth. Drainage by means of an external opening is often absolutely necessary.

Tumours of the Upper Jaw

Many of the Simple Tumours springing from the upper jaw have been already described amongst those involving the alveolar border and antrum. Only a few remain to be dealt with.

Osteoma occurs either in the form of a tumour composed of compact tissue then usually growing within the antrum or occasionally as a diffuse symmetrical overgrowth constituting the condition known as *leontiasis ossea*. A few cases of **Chondroma** have also been reported.

Leontiasis ossea is a disease fortunately very rare which commencing in young adult life progresses slowly but relentlessly and may at length destroy the patient after causing a great amount of suffering. Nothing is known as to its origin except that it may commence in the ethmoidal sinuses as an inflammatory process of feeble virulence and spread as a creeping periostitis. It affects either

the cranial or facial bones, or both, and consists in a development therefrom of nodular masses of soft spongy bone, embedded in which are areas of fibrous tissue. When affecting the facial bones, the projections may become very marked, and give the patient a hideously repulsive appearance, with a more or less leonine aspect (Fig 558). As growth progresses, the new bone encroaches on the cavities of the skull, the antrum, the orbits, or even the cranial cavity, and thus exophthalmos, neuralgia and finally coma may be produced. No satisfactory treatment is known, although attempts to chisel away the masses have been made.

Malignant Disease of the Upper Jaw occurs in the form of sarcoma or cancer. *Sarcoma* is perhaps the more common and originates either from the anterior wall, from the cavity of the antrum from the sphenomaxillary fossa behind the bone, or may extend into the maxilla from the nasopharynx. Not unfrequently these growths have a considerable ossific basis, and this is sometimes so extensive as to obliterate the antral cavity, and convert the bone into a solid mass (Fig 559). *Carcinoma* develops in the form of a squamous burrowing epithelioma, springing from the mucous membrane of the anterior ethmoidal region, or commencing in the mucous glands of the lining membrane of the maxillary sinus (Fig 560).

The Clinical Features of both forms of malignant disease are practically identical.

If arising from the anterior aspect of the bone, a tumour is produced which projects under the cheek, the tissues of which are invaded, it extends down towards the mouth, and is readily detected through the mucous membrane. It may however, spread deeply and involve the cavity of the antrum. It causes no obstruction to nasal respiration, and no epiphora except in the later stages.

If it originates *within the antrum*, or, as is more common, from the antro-ethmoidal region, the usual signs of distension of that cavity are produced, associated with a foul, and often blood stained, discharge from the nose, within which the ulcerated surface of the growth may be seen. Epiphora is caused by pressure on the nasal duct, whilst the growth has been known to burrow upwards along this passage and project near the inner canthus. The passage of air through the nose on that side is impeded, and the palate may be de-

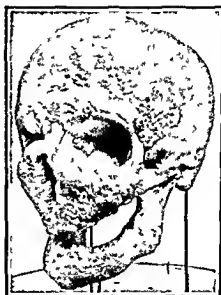


FIG 558—LEONTIASIS OSSEA (ROYAL COLLEGE OF SURGEONS)

pressed. The growth may also extend up the infundibulum to the ethmoidal cells and frontal sinus or it may erode the antral roof and invade the orbit.

If the growth commences *behind the maxilla* it usually springs from one of the walls of the sphenomaxillary fossa or from the base of the skull and is then characterized by a great tendency to spread in all directions. It may push the whole bone bodily forwards without encroaching upon the antrum sometimes it finds its way outwards to the pterygoid fossa through the pterygomaxillary fissure or inwards to the nose through the sphenopalatine foramen or even up into the orbit whilst more rarely it spreads down along the posterior palatine canal so as to appear at the postero-external corner of the palate in



FIG 559—SARCOMA OF UPPER JAW



FIG 560—MALIGNANT DISEASE OF UPPER JAW

the later stages the antral cavity is also involved and even the base of the skull eroded.

The General Signs of a malignant tumour of the superior maxilla consist in the appearance of a growth which in its earlier stages may produce various effects but finally destroys the bone and occupies the whole maxillary region (Fig 560). It is often associated with nasal obstruction epiphora and a discharge of blood or pus from the nares. Severe pain sometimes accompanies the process usually affecting the second division of the trigeminal. Neighbouring lymphatic glands are enlarged very late in the disease those in the submaxillary region are first involved and afterwards those in the anterior triangle secondary deposits in the viscera may also occur somewhat later. The tumour

follows a typical malignant course and owing to the great vascularity of the parts its onward progress is very rapid

The only chance of improving the results of treatment of this condition lies in an early **Diagnosis** and to secure this a thorough and systematic nasal examination (p 985) is essential in all cases of chronic obstruction to or discharge from the nose Transillumination and radiography must not be neglected in doubtful cases When the growth is sufficiently large to determine outward swelling of the cheek or palate or complete obstruction of one nostril or of the nasal duct with epiphora the chances are that the disease is beyond the range of cure by operative treatment

Treatment consists in free removal of the growth with a good margin of healthy tissue around it together with the lymphatic area involved Thanks to improved technique and earlier diagnosis the old and mutilating operation of removal of the upper jaw is now rarely necessary

When the growth is antral or antro nasal in origin it usually tends to spread in all directions except downwards through the palate being held up until late by the periosteum covering the antral floor or later still by the periosteum on the buccal side of the palate In most cases therefore the palate can be preserved and the growth although very extensive removed by Mours operation

When the palate alveolus and cheek are involved it is usually wiser not to operate but to attempt to control the growth by means of radio-therapy and to relieve pain by drugs

Lateral Rhinotomy (Mours operation) is the most effective and satisfactory method of removing growths of the maxilla or neighbouring portions of the nasal cavity which do not encroach on the mouth The interior of the nose is treated with cocaine and adrenalin the patient anæsthetized and the posterior choana plugged Endotracheal anæsthesia is desirable An incision is made from just below the inner end of the eyebrow (Fig 561) down the side of the nose skirting the ala nasi the upper lip is split in the mid line and the whole cheek turned back to get free access if the growth is extensive The soft tissues are dissected back so as to expose the infra orbital border and the bony margin of the anterior nasal orifice from which the cartilages are detached Incisions are then made through the bone with hammer and chisel as follows (Fig 561A area 1) One upwards and outwards through the nasal process of the superior maxilla or between it and the nasal bone or further inwards if necessary a second more or less parallel to it running from the lower border of the nasal aperture to the infra orbital border close to the infra orbital foramen and a third joining the two and running parallel to the infra orbital border either on the facial or orbital aspect as is thought best The portion of bone thus marked out usually including a small section of the floor of the orbit is twisted out of its bed by forceps laying bare the lachrymal sac and canal The amount of bone removed varies necessarily with the case but a considerable opening into the antrum and nasal cavity is secured and growths in this region can be readily removed if need be piecemeal without grave hæmorrhage or serious

mutiation. The incisions are subsequently closed by sutures and the resulting deformity is very slight.

If the growth be limited to the lower part of the nasal fossa, in the region of the inferior turbinal bone or to the antrum without involvement of the floor of the orbit—but often with infiltration of the palate—there is no necessity to make an external incision as in Moore's operation.

The upper lip is raised and an incision is made through the mucous membrane and periosteum above the alveolus and parallel to it. The periosteum is elevated and the antrum is opened through the canine

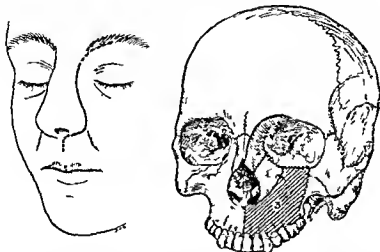


FIG. 561.

FIG. 562.

FIGS. 561 AND 562.—LATERAL RHINOTOMY (MOORE'S OPERATION)

In Fig. 561 the extent of the cutaneous incision for a limited operation is indicated by a thick line. Area 1 of Fig. 562A can be dealt with in this way. If the ethmoidal and frontal sinuses are invaded the incision is carried upwards and outwards along the dotted line and the area 2 in Fig. 562A can be cleared. If a large extent of the superior maxilla or part of the upper alveolus is involved the lip is split along the lower dotted line and area 3 can be operated on and removed if necessary.

fossa. As much as necessary of the front wall of the antrum of the lateral wall of the nose and of the palate is removed together with the neoplasm.

A very clear view is obtained and through the wide opening diathermy may be applied or radium be inserted immediately or on a subsequent occasion.

This operation is an extension of that of Denker for drainage of the maxillary sinuses.

Excision of the Upper Jaw *en masse* is now seldom employed except to satisfy the enquiries of examiners.

The Lower Jaw.

The mandible may be considered as a mixed bone, because it is formed chiefly from membrane, but also from cartilage. At birth it consists of two halves, connected at the symphysis menti by fibrous tissue. The rami are short, so that each condyle is nearly on a level with the upper border of the symphysis. During the first year osseous union takes place. As adult life is reached, the body of the mandible increases in depth, the rami lengthen, and the angle decreases, while the mental foramen gradually assumes a position midway between the superior and inferior borders. In old age, if the bone becomes edentulous, the whole of the alveolar border undergoes absorption. If teeth are extracted in adult life, the alveolar margin becomes absorbed as can be seen in Fig. 562.

Infections of the Jaw.—

Septic infections of the mandible are quite common, and it is curious that they are not more so, considering the very septic state in which the mouth is often found to be.

Osteomyelitis of the Lower Jaw.—Two distinct varieties may be recognized.

(1) Extensive acute involvement, which simulates acute osteomyelitis of the long bones.

(2) Localized necrosis, due to local infection.

The acute form is very severe and is often fatal, but, fortunately, is rarely seen. The infection may be blood borne, or it may reach the bone from an adjacent infection in the teeth. As the lower jaw obtains its blood-supply internally from the inferior dental artery, and externally from vessels supplying the periosteum, it can be imagined that various forms of disease exist according to the source of the infection. The whole of the narrow cavity is supplied by the inferior dental artery, which is enclosed in a dense canal, and if this artery is occluded by septic thrombosis, there is destruction of a large part of the lower

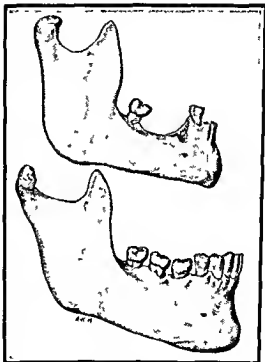


FIG. 562 — TWO JAWS FROM PEOPLE OF THE SAME AGE

The upper one shows how the alveolar margin atrophies on removal of the teeth

jaw As a rule the whole of the alveolar process carrying with it the teeth may necrose and become separated Sometimes a week or so after one side of the jaw becomes infected the other side follows suit There is a general constitutional reaction with high temperature and at times rigors the disease if not fatal follows the course of osteomyelitis of the long bones

In those cases where the disease is caused by extension of infection from the mouth either from an infected tooth or from an injury there may be a much more severe reaction owing to the fact that the infection is not due solely to the *Staphylococcus pyogenes aureus* but to a mixed infection in which a variety of organisms take part In such cases extensive suppuration of the soft tissues of the neck may supervene and there may be extension down the fascial planes of the neck into the mediastinum a fatal mediastinitis resulting

Treatment should be conservative on the whole It may be necessary to incise the periosteum and drill the bone Owing to the density of the osseous tissue of the lower jaw it takes a long while

for the necrotic bone to become extruded—much longer in fact than in the long bones It may take several months or even years before all the sequestra finally become separated The sequestra can be easily demonstrated by the use of X rays (Fig 563) and in removal the surgeon should be careful not to fracture the jaw as this can quite easily be done owing to the weakness of the surrounding involucrum



FIG 563—SKIAGRAM OF CASE OF OSTEOMYELITIS OF LOWER JAW SHOWING SEQUESTRUM

Local Necrosis—This condition is quite common and usually is the result of infection from the teeth The third

molars appear to be the chief offenders no doubt because they are most commonly misplaced and unerupted Trismus is often a sign which requires to be fully interpreted and here an X ray will often clinch the diagnosis The treatment should be carried out essentially by a dental surgeon

Infections of the lower jaw occasionally follow the use of certain drugs especially if there is some oral sepsis present at the same time The drugs which may cause necrosis are mercury arsenic and antimony Some patients are very susceptible to these drugs and even the local use of arsenic in the preparation for filling a cavity in a tooth may lead to quite extensive destruction of the portions of the jaw

In cases of syphilis where there is extensive dental caries the use of mercury and arsenic in the treatment of the disease must be carefully watched otherwise extensive necrosis or complete destruction of the alveolar process may take place It is in the treatment of such

cases that the co operation of surgeon and dental surgeon is so essential

Necrosis may be seen at times during the course of one of the exanthemata, especially in young children, when it may be a fatal condition Measles, scarlet fever, typhoid, chicken pox, and small pox have all been known to be the causative agent in necrosis of the jaw In these cases an attitude of conservatism should be always adopted

Phosphorus Necrosis is rarely met with at the present day owing to the fact that amorphous phosphorus is now used instead of yellow phosphorus in the manufacture of matches Many museums in the country, however, possess excellent specimens illustrating this condition (Fig 564) The lower jaw is affected equally with the upper, and it was quite a common observation that both were affected at one and the same time The fumes given off from the yellow phosphorus gain access to the jaw generally through carious teeth and set up an inflammatory reaction Salivation and swelling of the gums and bone take place, and this is followed in quick succession by necrosis of the bone The teeth become loosened, and finally drop out, and there is an exudation of pus from the empty sockets The patient's health deteriorates rapidly owing to septic absorption, anæmia, and exhaustion due to anorexia, death may even take place from these complications Sequestra both large and small, are gradually formed, but take a long time to become sufficiently loose to be exfoliated When a sequestrum separates or is removed however, it is found to be of a curious yet characteristic appearance, it is bossy and porous and may be likened to coarse pumice stone



FIG 564.—SPECIMEN OF LOWER JAW SHOWING PHOSPHORUS NECROSIS FROM A MAN AT 35 WHO HAD BEEN ENGAGED IN LUCIFER MATCH MAKING FOR MANY YEARS (R C S MUSEUM)

As a rule a considerable involucrum forms, and the lower jaw may be reconstituted again after separation of all the sequestra Even after the separation of what appears to be the whole of the lower jaw in the form of a sequestrum, the jaw is remarkably re formed, and a denture can be worn at a later date

Treatment should be conservative with the removal of loose sequestra where necessary, the great essential being to build up the general health of the patient

Radium Necrosis—This is a form of necrosis which has appeared with the advent of radium treatment for cases of carcinoma of the tongue It is probably the most chronic and most painful form of necrosis which affects the lower jaw It is preventable to a large extent, for the radium should be protected in a lead screen Cases do arise, however, where every precaution has been taken, and the

necrosis which is heralded by chronic burning pain often for a month or more becomes manifest firstly by X rays before any clinical signs are forthcoming. Months pass before any clinical evidence of necrosis is to be seen and sequestra slowly form and take a very long time to separate. Two or three years is often the actual time period for the separation of minute sequestra. In this condition again conservatism is the treatment any active interference causing a mixed infection and an osteomyelitis of the mandible.

Actinomycosis of the Jaw—The lower jaw is quite commonly infected with the ray fungus the infection commencing in a carious tooth or an abrasion of the mucous membrane by a tooth plate or a hard particle of food. There is some swelling of the bone which eventually leads to necrosis. Multiple abscesses form which in turn form sinuses and these discharge sticky exudate containing the well known granules. Excessive fibrosis takes place about the sinuses and the tissues appear to be markedly indurated. If the disease is not treated slow extension takes place into the muscles in the neighbourhood and the jaw may become fixed causing difficulty in swallowing and breathing. The veins may be compressed or occasionally erosion takes place with generalized metastatic deposits of the disease which kill the patient.

The Prognosis is far from hopeless and is quite good if the condition is still localized to the lower jaw.

Treatment must be local and general. Excision of all necrotic tissue is essential and the area should be packed with gauze soaked in tincture of iodine. These packs should be changed daily. Indurated masses and sinuses should be incised and packed with iodine gauze.

The general treatment consists in giving large doses of potassium iodide up to 1000 grains per diem. If the patient develops signs of iodism the dose should be doubled not halved. The treatment should extend over six weeks or two months. X ray treatment has given good results in some cases.

Vaccine treatment may be tried as an adjuvant method of treatment but is not so satisfactory as intensive potassium iodide treatment.

During the treatment it is essential that the general health of the patient should be maintained by the use of a suitable nourishing diet and a tonic if necessary.

Tumours of the Lower Jaw—Innocent tumours are rare they consist of osteoma chondroma myxoma lipoma and fibroma.

Osteomata may be ivory or cancellous. The ivory osteomata occur in the region of the neck and condyle of the mandible. The tumour is usually single and is found as a smooth hard mass covered with periosteum. Growth is slow but such tumours may cause limitation of movement at the temporo mandibular joint. Excision is difficult and fracture of the neck of the mandible may result if precautions are not taken to prevent this. **Cancellous osteomata** are more common than the ivory and may be met with near the symphysis or in the region of the lingula. Their removal may be difficult owing to the fact that they may be growing from the inner side of the mandible. **Chondromata** are occasionally seen they arise most commonly in the region of the condyle or the symphysis and may be mistaken clinically

for osteomata. **Myxomata** are very rare tumours in relation to the mandible and it is quite possible that they may be due to degenerative changes occurring in fibromata chondromata or lipomata. **Lipomata** when present are often subperiosteal in situation and are rarely diagnosed correctly. The tumour is often very hard and is mistaken for an osteoma but X ray examination does not reveal a bony tumour. The correct diagnosis is only made on exploration when the tumour can be completely removed and the diagnosis confirmed by the microscope. **Fibromata** may occur in any part of the mandible they grow from the periosteum and form hard tumours which may become pedunculated if growing from the inside of the jaw as they then come into contact with the tongue which soon exerts a suction traction action on the tumour. Excision is a simple matter if left alone they slowly increase in size and later may become sarcomatous.

Malignant tumours are more common and vary considerably in the nature of their malignancy. **Osteoclastoma** may occur as an endosteal growth which slowly expands the body of the jaw. It generally presents but slight evidences of malignancy and may be treated in the first place by opening the outer shell of bone through the mouth scraping away the soft dusky purple contents and plugging the cavity with gauze after having swabbed it out with pure carbolic or tincture of iodine. If the case is a late one and the jaw much expanded the cavity may be filled with bone chips to help the consolidation of the bone. If recurrence takes place the cavity should be scraped out once more and some radium needles be inserted after the cavity has been filled with bone wax. The needles are left in for six or seven days they are then removed with the wax and the wound allowed to granulate.



FIG 565—SKIAGRAM OF SARCOMA OF THE LOWER JAW

Sarcomata form the commonest malignant tumours of the mandible and every type of osteogenic sarcoma may occur. The periosteal variety is very malignant and shows an excessive amount of new bone laid down in radiating laminae on the other hand it may simply show a large gap in the bone (Fig 565). The best form of treatment is deep X ray therapy but some cases treated with the radium bomb have given good results. Excision of half the mandible may be undertaken if suitable X ray or radium therapy is not available (Figs 571 573). Small doses of radium or X rays only aggravate the condition.

Endosteal Sarcoma often arises in the horizontal ramus and the

condition may be mistaken for chronic osteomyelitis especially if too much stress is placed on the X ray appearance. In cases of doubt a biopsy should always be obtained to confirm the diagnosis. Excision of half the mandible may be undertaken or the case may be treated by deep X ray therapy. Secondary sarcomatous deposits may rarely be seen in the lower jaw. They appear as hard masses which on X ray examination often appear to be cystic. Such deposits are seen only in the advanced stages of sarcomatosis where secondary deposits are to be found all over the body. Malignant Melanoma may be seen occasionally growing from the lower jaw. Some thirty cases are reported in the literature. The growth forms a bluish black lump growing from the inner or outer surface of the horizontal ramus. Histologically the tumour is very cellular of sarcomatous structure the spindle cell predominating. Excision of half the jaw should be



FIG 566—OSTEOGENIC SARCOMA OF THE LOWER JAW



FIG 567—SARCOMA OF THE LOWER JAW IN A CHILD

undertaken. Carcinoma may invade the jaw from the tongue or the floor of the mouth and is of the squamous-celled type (Fig 568). Wide excision of the bone together with the primary disease is always required unless it has extended so far as to render extirpation impracticable. In such cases radium treatment should be undertaken. Columnar-celled Carcinoma is rare. It commences in epithelial rests in the peri-odontal membrane and spreads into the jaw. The treatment is similar to that outlined above. Secondary Carcinoma may occasionally be seen in the jaw in advanced cases of carcinomatosis the primary disease being in the breast, prostate, thyroid or kidney. The X ray appearances are characteristic of secondary carcinoma in

the long bones. Endothelioma may rarely be seen in the lower jaw. It arises in connection with the blood vessels and is found growing from the alveolar process. Diagnosis is often difficult even when a piece has been removed for histological examination. Treatment should consist of local excision of the jaw in the region of the tumour.

Fibrocystic Disease of the Lower Jaw (Adamantinoma, Epithelial Odontoma)—This is a rare disease but one which is well known. It is an epithelial tumour arising in connection with the enamel organ and may be regarded as a type of adenoma. The tumour is innocent in nature but spreads into the surrounding bone of the jaw (Fig 569). In some cases the tumour undergoes some calcareous degeneration which may readily be seen in an X-ray photograph. In other cases the whole of the lower jaw may be converted into definite cystic masses (Fig 570). Histologically the tumour consists of a mass of epithelial lined spaces surrounded by dense fibrous tissue this appearance having led to the name fibrocystic. It is not necessary in all cases to remove half the lower jaw but the tumour should be enucleated.



FIG 568—CARCINOMA OF THE LOWER JAW
The disease has spread from the floor of the mouth

Excision of the Lower Jaw

—This is an operation which is rarely performed at the present day. Partial removal may be necessary in the removal of epulides; this consists generally of the removal of a portion of the alveolar border together with the growth.

Resection of the median portion of the lower jaw is undertaken for those cases where there has been an extension from a carcinoma of the under surface of the anterior part of the tongue from a carcinoma of the floor of the mouth or even from a carcinoma of the lip. Before undertaking such an operation it is very important that all separate foci in the mouth should be removed. Intratracheal gas and oxygen is the best form of anaesthesia and allows the pharynx to be plugged with gauze so that no blood or saliva can enter the air passages during the operation. The diseased area is enclosed by two incisions which converge in the mid line just above the hyoid bone. The divided vessels are secured and the lower jaw is divided by a saw and removed. The two halves of the jaw are then united by means of a piece of stout catgut or kangaroo tendon which is passed through two drill holes on either side. The skin flaps are undermined and brought together, it may be necessary to relieve the tension of the flaps by some lateral

incisions. It is essential to suture the lip carefully so that the red margin on one side coincides exactly with that of the other. Drainage is essential the tube being placed in the lower part of the incision.

Excision of Half of the Lower Jaw—This operation is performed for cases of malignant disease. Intratracheal gas and oxygen anaesthesia and plugging of the pharynx with gauze is imperative. With the head turned to the opposite side an incision is made commencing in the centre of the lower lip and passing downwards to a point immediately below the symphysis (Fig 569). It is then carried along the under surface of the body of the mandible and as far as the angle. The incision is then prolonged upwards along the posterior border of the vertical ramus as far as the lobule of the ear but no further because of the danger of cutting the facial nerve.



FIG 569.—SPECIMEN OF CYSTIC ADENOMA OF THE LOWER JAW (R.C.S. MUSEUM)

While making the incision over the posterior part of the body of the mandible the fascial vessels are encountered and secured between ligatures. The large flap is turned upward, and the muscles attached to the jaw which are not involved or in contact with the tumour are elevated by a periosteal elevator (Fig 572). The muscles on the inner side of the jaw are dealt

with in a similar manner care being taken that the mucous membrane of the mouth is kept intact. The central incisor tooth is extracted and the jaw divided through the empty socket with a small saw and cutting pliers a little to one side of the middle line. By this means the genial tubercles and their attached muscles are not

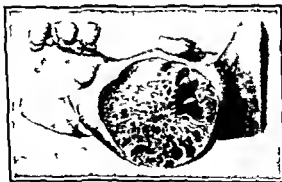


FIG 570.—FIBRO-CYSTIC DISEASE OF THE LOWER JAW (R.C.S. MUSEUM)

damaged and so the movements of the tongue are unimpaired. The bone is now pulled outwards and its internal attachments are brought into view and divided care being taken to secure the inferior dental vessels just before they enter the canal in the bone. By depressing the jaw

the tendon of the temporal muscle is exposed and its attachment to the coronoid process can be severed by a few touches with the knife. Lastly the condyle of the jaw is freed after cutting through the tendon of the external pterygoid muscle and the capsule of the temporo-mandibular joint (Fig 573). Care should be taken not to divide the internal maxillary artery which is in close proximity to the inner surface of the neck of the mandible. As a rule hæmorrhage is quite easily controlled and the wound can be stitched together with interrupted silkworm gut sutures, a drainage tube being inserted at the posterior end. Care should be taken in approximation of the lip so that the red margin is continuous on both sides of the incision. The wound is dressed with gauze in which one or two marine sponges are incorporated to give firm pressure and prevent the occurrence of a hæmatoma. The drainage tube should not be removed until all oozing has stopped which is generally about the third or fourth day after the operation. The wound heals well and there is little post-operative pain. The patient can be allowed out of bed on the second day and



FIG 571 —THE INCISION FOR REMOVAL OF HALF THE LOWER JAW



FIG 572 —OPERATION FOR REMOVAL OF HALF THE LOWER JAW

The skin flap is raised and the masseter muscle cut through



FIG 573 —INCISION OF HALF THE LOWER JAW

The bone has been divided in the middle line and its final muscular attachments are severed

can generally leave hospital about the tenth day. Considerable deformity usually results from this operation owing to the remaining half of the bone being drawn across the middle line, but if necessary, this often can be overcome by a plastic operation at a later date. The co-operation of a dental surgeon will often help in obtaining a

good result by the use of a suitable denture. Although excision of half the lower jaw appears to be quite a simple operation there are a number of pitfalls which the surgeon should endeavour to avoid. First and foremost gentleness is all important as a fracture may result at or near the site of the tumour. The pharynx may be opened if the knife is not kept close to the bone while separating the soft parts from the region of the angle of the jaw. The internal maxillary vessels may be wounded and give rise to troublesome hæmorrhage which is difficult to locate and control.

Leontiasis Ossea.—The lower jaw is frequently involved in this uncommon disease in fact in some cases it appears to be the first bone of the face to become affected. The bone is enlarged, sclerosed and pitted as if a creeping periostitis had taken place. The jaw



FIG 574.—LEONTIASIS OSSEA AFFECTING THE LOWER JAW OF WOMAN AGED 31

FIG 575.—FULL FACE PHOTOGRAPH OF THE SAME PATIENT

appears enlarged in every direction and the patient is often very conscious of this fact. There is no known treatment for the condition but small abscesses may form around some septic teeth which are often embedded in a very dense mass of sclerosed bone (Figs 574-576). Extraction of the teeth may entail a very difficult surgical operation the only method by which the teeth can be removed being by an electrically-driven burr or chisel.

Osteitis Deformans (Paget's Disease).—Although the bones of the cranium are commonly affected in this disease the facial bones and lower jaw only show slight involvement. In a few recorded cases the lower jaw has been markedly affected and enlarged. On X-ray examination the jaw appears to have cystic spaces connected by multiple trabeculae throughout its entire length. The dried bone is quite porous.

Osteo-Arthritis is by no means rare in this joint, although it is quite often overlooked as a cause of pain in the joint. With modern methods of radiology the condition can be seen quite easily on a skiagram. The condition may be symmetrical, and is characterized by considerable enlargement of the condyle of the jaw, which causes it to bulge laterally so that it can be felt in front of the tragus of the ear. Movements of the joint are painful and limited and crepitus can nearly always be elicited. If the condition is bilateral, the lower jaw appears to be pushed forwards rendering the chin quite prominent. If however, the condition is unilateral the jaw becomes deflected to the sound side. Loose bodies may form in some cases, and may cause 'locking' of the joint while in others there is extensive lipping of the periphery of the condylar cartilage proliferation of the synovial villi and 'lipoma arborescens' may be in evidence. As the disease progresses the interarticular cartilage may disappear completely and the glenoid cavity, as it enlarges, may assume a flattened outline, so that a partial dislocation may even occur. If pain and limitation of movement are complained of the only satisfactory treatment is excision of the condyle, as all other forms of treatment are useless and a waste of time.

The operation of excision of the condyle of the jaw is carried out through a curvilinear incision, commencing over the middle of the zygoma, and passing downwards in front of the tragus. In this operation the surgeon is working in a somewhat cramped space with the zygoma above, the facial nerve below, the parotid glands in front, and the external ear behind.

After the skin and subcutaneous tissues have been incised, the small flap is turned upwards. A transverse incision is now made at the posterior end of the zygoma, opening up the capsule of the joint and the synovial membrane. The neck of the mandible is exposed, and a fine Gigli saw is passed round this with a small aneurism needle. The neck of the bone is cut through with this saw and the condyle removed. Sometimes the neck of bone may be divided with a small pair of cutting pliers. Any bleeding from the cut surface of the bone can be controlled by the firm application of some bone wax to the raw area. A small piece of celluloid can be placed over the cut surface of the bone and retained with a



FIG. 576.—SKIAGRAM OF PATIENT WITH LEONTIASIS OSSEA FROM WOMAN SEEN IN FIGS. 574 AND 575.

stitch. This prevents any chance of ankylosis of the joint. A piece of fascia may perform the same purpose, while some surgeons advocate the use of a portion of the tunica vaginalis testis. The wound is closed with two or three interrupted sutures, no drainage being employed. The patient is encouraged to move the joint at an early date. The results of such an operation as this are really gratifying, and patients are quite pleased.

Tuberculous Arthritis—It is often difficult to be certain whether tuberculous disease in this joint has arisen in the bone or in the synovial membrane. The affection itself is rare, and is only seen when the disease is fairly well advanced. It runs the usual course of any tuberculous joint affection, and ends in caries of the condyle. Secondary infection may occur, leading to ankylosis. The condition is



FIG. 577—SPECIMEN OF BONY ANKYLOSIS OF THE JAW OF MANY YEARS STANDING (RCS MUSEUM)



FIG. 578—DRAWING SHOWING HOW A STRIP OF THE MASSETER MUSCLE MAY BE USED TO ENSURE A FALSE JOINT AFTER EXCISION OF THE CONDYLE

very chronic and has been mistaken for osteo-arthritis on more than one occasion the true diagnosis only being made when excision of the condyle was performed and the bone subjected to microscopical examination. Excision of the condyle and thorough cleansing of the cavity of the joint followed by the application of BIPP, is the treatment for this condition.

Neuropathic arthritis of this joint is a very rare entity, a hypertrophic Charcot's arthritis has been reported in the literature.

Treatment for the different varieties of fixation of this joint will of necessity vary according to the causative conditions.

Fibrous ankylosis can be dealt with by excision of the condyle of the jaw described above.

Bony ankylosis (Fig. 577) often presents a difficult problem, owing to the fact that the surgeon is working in a limited space, and any

attempt to remove the neck or head of the condyle by means of a chisel or osteotome may result in a fracture into the middle ear or injury to the facial nerve. A fine pair of nibbling forceps may be used and the bone in the region of the neck of the mandible be carefully removed piece by piece until the bone is completely divided. It is important to remove a considerable portion of bone so as to leave quite $\frac{1}{2}$ inch between the two surfaces. A piece of fascia lata celluloid or muscle graft should be inserted between the bony surfaces so as to ensure a false joint and prevent any bony union (Fig 578). It is often possible to turn in a flap of the temporal muscle without extending the incision and without interfering in any way with the action of the muscle itself. In bilateral cases after the stitches are removed it may be necessary to move the jaw repeatedly under gas anæsthesia to ensure free movement. The end results in these cases depend to a large extent on the patients themselves the persevering ones get excellent results while the nervous patients who will not try to move their jaws often complain that the operation has been a failure and that they are little benefited by the surgical intervention. The surgeon should try to assess each patient before undertaking the operation when he will be able to gauge the probable reaction in each case. Some patients should never be operated upon as failure is assured by their behaviour prior to operation.

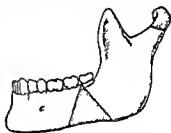


FIG 579.—DRAWING SHOWING THE EXTENT OF BONE REMOVED IN EXCISION OF THE CONDYLE AND IN ESMARCH'S OPERATION

The most difficult cases to relieve or cure are those in which there is much cicatricial contraction round about the joint. Division or excision of the adhesions is useless as during healing fresh adhesions form and the condition is unrelieved. In these cases therefore

Esmarch's operation often gives good results (Fig 579). This operation consists of the removal of a wedge of bone with its apex towards the alveolar border from the neighbourhood of the angle of the mandible. A portion of the detached masseter muscle is turned in between the two bony surfaces so that an artificial joint is formed. The incision should be made below and behind the angle of the jaw this gives good exposure and allows the muscles to be separated from the outer and inner surfaces of the mandible. The bone can most conveniently be divided by the use of a Gigli saw. An alternative method is to remove the vertical ramus of the jaw down to the level of the alveolus but this method does not give so satisfactory a result as Esmarch's operation.

Diseases of the Temporo-Maxillary Articulation

Acute Synovitis may supervene in the course of an attack of rheumatic fever, and is evidenced by pain on movement of the jaw and by

tenderness and swelling immediately beneath the root of the zygoma due to effusion into and around the joint. Resolution generally follows but fibroid thickening of the ligaments and impairment of movement may result.

Acute Arthritis arises from pyæmic infection after the exanthemata or from gonorrhœa but may be caused in children by direct extension of inflammation through the tympanic plate from the middle ear as in scarlatina. It is characterized by the usual signs of a severe localized inflammation with the formation of abscesses and results commonly in ankylosis. Fomentations and the opening of abscesses constitute the only early treatment whilst excision of the condyle is sometimes required later.

Tuberculous Disease may arise either in the bone or synovial membrane perhaps spreading to it from neighbouring lymphatic glands. It runs the usual course of the disease terminating in caries of the condyle.



FIG 580.—DISPLACEMENT OF THE MANDIBULAR CARTILAGE

Internal Derangement of the temporomaxillary joint (locking or clicking jaw) is not a very uncommon affection resulting from laxity of the interarticular cartilage which gets caught between the condyle and the eminentia articularis when the mouth is opened. The effect is a temporary painful fixation or locking of the jaw which is usually set free by lateral movements. At other times there is marked clicking or creaking of the jaw when the mouth is opened. The actual displacement of the mandibular cartilage is probably due mainly to the

shape and attachment of this meniscus. The fibro-cartilage is a dome-like structure very closely applied to the convexity of the mandibular condyle. As far as thickness is concerned it is irregular being very much thicker in its centre and anteriorly. Between these two thickenings there is a distinct depression. The posterior part of the cartilage is very thin and passes well down over the posterior surface of the condyle and fuses behind with the capsule. Rarely the posterior part of the mandibular cartilage actually becomes detached and is pulled forwards (Fig 580). In bad cases treatment consists in excising the loose cartilage through a T shaped incision. In the milder cases nothing can be done except to assist in the removal of the synovial effusion by blistering.

CHAPTER XXXI

AFFECTIONS OF THE MOUTH, SALIVARY GLANDS, AND PALATE.

Stomatitis, or inflammation of the mucous membrane of the mouth, is by no means uncommon, especially in children

1 **Catarrhal Stomatitis** results from mechanical irritants, such as roughened teeth from irritating chemicals, or from septic inflammation following operations which involve the mouth, and is undoubtedly increased, if not initiated, by excessive smoking. It also arises in the course of fevers and in conditions of debility such as follow measles and other exanthemata in children or is associated with disturbances in the alimentary canal, as from improper feeding, dyspepsia, etc. The mucous membrane becomes hyperæmic and swollen, usually in small localized patches which may gradually spread and become confluent, involving nearly the whole of the oral cavity. The exudation of mucus is increased and becomes viscid and turbid, whilst the epithelium at first white and sodden, is after a while rubbed off, leaving superficial erosions or distinct ulcers, which are very painful. The treatment consists in the removal of all sources of irritation and the administration of drugs to correct intestinal derangements. Anti-septic mouth-washes should also be employed such as sanitas (1 in 20), boro glyceride (1 in 20), chlorate of potash, Condy's fluid, peroxide of hydrogen, or dettol.

2 **Aphthous Stomatitis** occurs in badly-fed children in the form of small whitish spots on a hyperæmic base, which run together and produce ulceration. Attention must be directed to the general condition, and a little borax and honey or a solution of boro glyceride (1 in 20) applied locally. Thrush is due to the presence of a parasitic fungus, the *Oidium albicans*, and occurs in patches somewhat resembling curdled milk in appearance. In history and treatment it resembles the aphthous variety. In both types there is often some enlargement of the lymphatic glands, which, however, frequently subsides without suppuration.

3 **Gangrenous Stomatitis**, or cancrum oris, has been already described (p. 124). A similar condition occurs in elderly debilitated people, especially if suffering from albuminuria or diabetes and the possessors of foul teeth.

4 **Mercureal Stomatitis** is now rarely seen, except in persons who are unduly sensitive to the action of mercury. It is aggravated by dirty teeth, or if the patient smokes to excess. The gums are swollen and tender, bleed on pressure, and are very painful, especially when biting, or drinking hot fluids. The teeth may become loose and fall out, whilst the alveolar borders may be laid bare and necrose. The

tongue is sometimes swollen and inflamed salivation is a marked symptom and the breath becomes very offensive *Treatment*—Leave off the mercury or at any rate reduce the dose considerably and administer saline purgatives Chlorate of potash combined with alum dilute hydrochloric acid or tincture of myrrh may be useful locally.

5 For Syphilitic Stomatitis see p 163

The buccal mucous membrane is also involved in the course of other diseases e.g. diphtheria scarlet fever and erysipelas but special descriptions are not needed here

Affections of the Tongue

Congenital Abnormalities—(a) The tongue has been completely or partially absent (b) One half of the tongue is defective in size (*hemiatrophy*) (c) *Tongue-tie* is said to be present when the frænum is shorter than usual causing the tip to be depressed and fixed in the floor of the mouth so that it cannot be protruded Sucking becomes difficult in such a condition and when it is allowed to persist there is often a lisp in the speech *Treatment* is only needed in the severer forms and consists in raising the tongue with the index and middle fingers placed one on either side and snipping the frænum thus put on the stretch across its centre with a pair of blunt pointed scissors directed downwards (d) The tongue may be adherent to the floor of the mouth being *bound down* by folds of mucous membrane (*ankyloglossia*) This may also exist as an acquired condition due to cicatricial contraction after ulceration In congenital cases the adhesions are but slight and the organ can be readily freed in the acquired condition this cannot always be accomplished (e) The frænum and tongue are occasionally too long allowing of increased mobility and even fatal results have occurred from the organ rolling backwards and impeding respiration (f) The tongue may be *cleft* presenting a bifid appearance this may be complete or partial and is usually associated with a congenital fissure through the lower lip and mandible (g) *Macroglossia* (or large tongue) although sometimes acquired is usually a congenital deformity The organ is enlarged in all directions and protrudes from the mouth so that the teeth indent it and cause ulceration and considerable interference with the venous return It thus becomes purplish and dry from exposure the mucous membrane looking almost like skin although saliva dribbles freely from beneath it In old-standing cases the teeth are displaced outwards and the jaws deformed so that even if the tongue is reduced to its normal size by treatment it may be impossible to close the mouth Pathologically it is to be looked on as lymphangiectasis (p 379) of congenital origin and associated with diffuse overgrowth of the connective tissue Recurrent attacks of *lymphangitis* add to the trouble the tongue gradually increasing in size and the disease has been known to terminate in the development of lympho-sarcoma The *treatment* consists in excision of a V shaped portion suturing the raw surfaces subsequently with catgut In some cases macroglossia

is an evidence of hypothyroidism, and some striking cures have been reported after the use of thyroid extract

Wounds of the tongue are usually caused by the teeth especially in children, either during an epileptic fit or as a result of falls. There is often brisk hæmorrhage for a few moments, but the blood may be extravasated into its substance, and causes considerable swelling. In simple cases the wound should be purified, and the mouth constantly cleansed. A few points of suture may be inserted if necessary, but the wound must not be entirely closed, or tension from infection will result. When smart arterial bleeding is present, the wounded vessel must be sought for and tied.

Acute Superficial Glossitis occurs as part of a general stomatitis, and needs no special notice.

Acute Parenchymatous Glossitis, or acute inflammation of the tongue may arise from penetrating and infected wounds, or from the bites or stings of insects, or may be associated with acute stomatitis in the course of fevers or with the injudicious administration of mercury. The condition may be limited to one half of the organ, but when arising from general causes is bilateral. The tongue becomes painful, swells up rapidly so as to fill the mouth and even protrudes beyond the teeth, the pressure of which leads to superficial ulceration. The salivary glands are enlarged and painful, and salivation is a marked feature in the case. Speech, swallowing and even respiration are much interfered with, and there may be considerable febrile disturbance. The case if treated with care, usually ends in resolution, but diffuse or localized suppuration may ensue as well as the most urgent dyspnoea, arising either from œdema glottidis or from the pressure of the enlarged organ. *Treatment* consists in stopping the mercury, or removing any evident cause and in the administration of saline purgatives with chlorate of potash. Ice should be sucked, and an ice poultice applied to the submaxillary region. In bad cases free incisions into the dorsum should be made on either side of the median line to give exit to the effused fluids and blood. If asphyxia is threatening, high tracheotomy or laryngotomy is required.

Abscess of the tongue may result from the acute process described above, but is more usually of a chronic nature, and situated at the anterior part of the organ. It is generally due to the admission of micro-organisms through some superficial lesion which has quickly healed. It presents as a tense swelling, fluctuation in which may be marked by the amount of inflammatory thickening which surrounds it. A free incision both settles the diagnosis and cures the case.

Sublingual Abscess, when acute is due to infection of the submucous tissue, as by puncture with a fish bone, or starts in a follicle of the sublingual or in a submucous gland. A puffy swelling forms beneath the tongue which if not opened early, may lead to an extension downwards of the mischief into the submental region. The tongue becomes swollen and turgid from pressure upon the veins, whilst œdematous laryngitis may also be induced. Considerable constitutional disturbance generally accompanies this process. A median incision through the mucous membrane, and the insertion and opening of a

pair of dressing forceps is the safest and best method of treatment the cavity being subsequently washed out and drained. The more diffused form of sublingual abscess is usually associated with submaxillary cellulitis (p. 70).

Chronic Streptococcal Glossitis—This condition is of fairly common occurrence and must be distinguished from a similar disease caused by syphilis. Adults are the chief sufferers generally females but children may be affected. The condition is caused by subepithelial activity of streptococci and by suitable measures it is possible to obtain cultures of the organisms from the submucous layer. The inflammatory signs may be more or less limited to the surface and appear as localized patches of hyperæmia and overgrowth of papillæ together with superficial heaping up of sodden epithelial squames in neighbouring regions by desquamation of these cells certain parts of the tongue become denuded and of a smooth appearance while in other places unfolding of the superficial layers gives rise to apparent fissuring. *Treatment* is as for chronic superficial glossitis.

Chronic Superficial Glossitis is an interesting and important disease which may be associated with a similar condition of the mucous membrane lining the interior of the cheeks and lips. It is most commonly due to tertiary syphilis but may arise from excessive smoking, ragged and rough teeth or spirit-drinking, chronic dyspepsia perhaps of a gouty nature being also present in many cases. It is very liable to be followed by epithelioma (25 per cent. of the cases).

For purposes of description it is useful to divide the disease into the following five stages although it must be clearly understood that they are artificial and several of them may be present in different parts of the same tongue. (i) The papillæ become enlarged and swollen leading to the appearance of red hyperæmic patches which cannot be recognized for certain unless the tongue is thoroughly dried with a handkerchief, towel or piece of clean blotting paper which must not be carelessly dabbed over the organ but should be firmly pressed down so as to absorb all the moisture. (ii) Overgrowth of epithelium follows and as it increases in thickness it becomes opaque and horny so that the red patches are replaced by white ones leading to the appearance which has been designated *Leucoplakia*. Sometimes the papillæ become much enlarged and stand out definitely and separately from the organ or the whole surface may be covered with dense white patches. To this condition the term *Ichthyosis* has been applied. (iii) Later on the excess of epithelium is shed leaving red smooth patches in which the papillæ are atrophied or have entirely disappeared. If this occurs over the greater part of the organ the *glazed red tongue* so characteristic of tertiary syphilis is produced. If however this process only occurs in smaller areas intermixed with portions covered with white epithelium a patchy appearance of the tongue results wrongly termed *Psoriasis linguae*. (iv) At varying periods of the disease sometimes earlier sometimes later the organ becomes ulcerated, *cracked* or *fissured* in a somewhat characteristic manner. A median fissure is usually seen running down the middle and from

this furrows extend transversely, dividing the surface into rectangular compartments. These fissures are not always due to the cicatrization of cracks as when opened out healthy papillæ are seen at the base, and no sign of superficial scarring. They are, then, evidently the result of the contraction of deep sclerosed tissue in the substance of the organ. Superficial ulceration often occurs, owing to some local irritation or to smoking, the atrophic condition of the mucous membrane explains the great liability to this occurrence. (v) Still later, epithelioma may develop, and usually in connection with one of the cracks or of the cicatrices arising therefrom. It is often somewhat slow in its progress, owing to the amount of sclerosis induced by the preceding inflammation.

The typical *smoker's patch* is a red irritable area on the front of the tongue, from which papillæ are often absent, and perhaps covered with a yellowish white crust. Sometimes the epithelium is heaped up here into a well marked leucoplakic spot.

The disease is always accompanied with much discomfort, the tongue being sometimes so tender that the patient cannot drink hot fluids or take condiments or stimulants without pain. The speech becomes thick and indistinct. The affection may settle down after a time, and remain quiescent, so long as the patient conforms to the restrictions as to diet etc., which are essential. If, however, he is careless or refuses to obey orders the trouble may progress, and epithelioma develops.

Treatment.—All sources of irritation are excluded from the mouth as a first precaution. Thus, smoking or chewing tobacco must be rigidly prohibited. Alcohol is forbidden, but if essential whisky well diluted is permitted. Condiments such as mustard, spices, curry, and cheese, are excluded from the dietary, and only simple unirritating ingesta allowed. The mouth is washed out frequently with an alkaline lotion *e.g.* bicarbonate of soda (20 grains to 1 ounce), or borax (10 grains to 1 ounce) especially after meals so as to exclude all risk of acid fermentation in the debris of food. The teeth must be brushed night and morning, and all stumps and rough excrescences removed, definite pyorrhœa must be carefully treated. Gaps between the teeth should be filled by artificial teeth fitted to a smooth plate. Cracks and sores may be treated by painting the surface with a solution of chromic acid (grs v ad ℥i) or of perchloride of mercury (grs ii ad ℥i), but it is better to excise them completely, as also any wart-like formation. Solid nitrate of silver should particularly be avoided, as its use is likely to predispose to epithelioma.

Careful attention is given to the digestion, and general antisyphilitic remedies are employed where necessary, even including salvarsan, but mercury must be used with discretion.

On the appearance of definite epithelioma suitable operative measures must be instituted, as radium therapy does not give good results in these cases.

Ulceration of the tongue arises from a variety of causes, and occurs in many different forms. Thus, dental or traumatic ulcers, due to the irritation of rough and carious teeth, are generally seen at the margins

of the organ. Dyspeptic ulcers are associated with gastric disturbances; they are usually located on the middle of the dorsum and are often very painful. Tuberculous ulcers are not common and are nearly always secondary to pulmonary or laryngeal phthisis. They commence in the form of a submucous abscess which bursts and leaves a small painful ulcer usually situated at the sides or on the dorsum near the tip. Secondary abscesses form around and coalesce with the original ulcer. Treatment is chiefly needed on account of the pain and discomfort and consists in complete excision or in cauterizing and scraping the sores touching the base with pure carbolic acid and dressing with iodoform. Applications of cocaine may also be made before meals as a palliative measure when radical treatment is contra-indicated because of the extent of the pulmonary mischief. Occasionally tuberculous disease appears in the form of a painful fissure which on being opened up reveals a mass of pulpy granulations and possibly caseating nodules lying in a cavity of some size; the margins of



FIG. 581.—GUMMA OF RIGHT SIDE OF TONGUE (FROM WAX MODEL IN COLLEGE OF SURGEONS MUSEUM)

the fissure are sometimes the seat of overhanging papillary growths (tuberculous papilloma). Excision is essential in these cases. All tuberculous lesions are naturally liable to become infected by the mouth bacteria and many diverse appearances result from this cause; apart from this all tuberculous ulcers are free from induration. Lupus also attacks the tongue but is very uncommon and almost invariably secondary to a similar affection of the skin of the face. In a case under our care it appeared in the form of an irregular granulating surface surrounded by nodulated cicatricial tissue of an exceedingly dense character. The progress was very slow owing to the amount of

sclerosis present. Treatment consists in the application of the X-rays or of radium.

Syphilitic Disease of the tongue occurs in a variety of different forms. A primary sore presents a characteristic indolent and inactive surface usually near the tip with subacute infiltration and much chronic enlargement of the submental lymphatic glands which however do not generally suppurate. In the secondary stage mucous tubercles, fissures and ulcers form and usually on the sides or near the tip. Occasionally a broad wart like condyloma develops on the dorsum which may be associated with longitudinal fissures; it is sometimes termed Hutchinson's wart. In the tertiary period chronic superficial glossitis occurs as also diffuse infiltration or gummata.

Gumma of the tongue is not uncommon, occurring usually in patients under forty years of age as a late tertiary phenomenon. It starts as a localized submucous or intramuscular infiltration near the median line and generally towards the middle or posterior part (Fig. 581). The swelling is at first hard and firm, but later on becomes soft and

fluctuating and in time the overlying mucous membrane which was unaffected yields and gives exit to the characteristic contents. The ulcer thus produced is oval or round in shape and deeply excavated the base being constituted by a slough. There is but little induration either of the base or edges and neither the floor of the mouth nor the base of the tongue is involved so that the organ can be freely protruded whilst deglutition and articulation are scarcely interfered with. The patient complains of little pain and the neighbouring lymphatic glands are seldom affected. The progress is slow and the effect of antisyphilitic treatment very decided the gumma being absorbed or the ulcer if present healing



FIG 582 — PAPILOMATA OF TONGUE SECONDARY TO CHRONIC SUPERFICIAL GLOSSITIS



FIG 583 — PAPILOMA OF THE TONGUE IN A BOY
ET 8

readily but leaving a localized area of sclerosis or a deep cicatrix from which malignant disease may subsequently originate. In some cases a diffuse infiltration of the organ occurs leading to a generalized sclerosis rather than to a localized gumma. The treatment consists in the administration of iodides with or without mercury and the mouth is kept clean with a simple mouth wash.

Innocent Tumours are not frequent in the tongue cysts lipoma and naevi being the chief varieties and requiring no special description.

Dermoid Cysts also form within or under the tongue occupying the

middle line projecting either into the floor of the mouth or beneath the chin. They are due to non obliteration of the upper end of the thyroglossal duct (p 1075). The contents are of the usual sebaceous type

The lower jaw itself is often invaded in the later stages of the disease. The occurrence of the typical cachexia is determined not only by the pain and consequent sleeplessness but also by the inability to

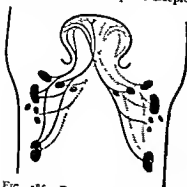


FIG 506.—DIAGRAM SHOWING THE LYMPHATIC DRAINAGE OF THE TONGUE

take sufficient nourishment, the absorption of products of putrefaction swallowed with the saliva, the excessive salivation, the occasional hemorrhages and the extent of the secondary growths. The patient rarely lives apart from treatment, for more than twelve months after the disease has been first noticed. Death is due to exhaustion hemorrhage, or septic pneumonia.

Diagnosis.—When a case is met with where the ulcer is situated at the side or base of the tongue in a patient over forty five years of age, with the typical enlargement of the glands, profuse salivation, and impaired movements, there can be

little doubt as to the diagnosis. But when it is seen in the early stage as an infiltration of a syphilitic fissure or cicatrix, or as a small wart, it may be difficult to determine whether or not malignant disease is present. The early enlargement of the glands, the amount and character of the pain, the fixity of the organ, and the infiltration of the base of the ulcer are important guiding marks, but in doubtful cases a small portion of the edge of the growth and of the adjacent parts should be excised under cocaine and subjected to careful microscopic examination and thus its nature ascertained. Moreover, the fact of improvement after the administration of steadily increasing doses of iodide of potassium does not exclude the presence of cancer, as the two conditions so often co-exist.

Treatment.—The only hope of curing the patient lies in thorough and early removal of the growth which it should be remembered has probably extended much further than one expects. The excision must include not only the tumour but also a wide area of tissue around it so as to get well beyond the zone of infiltration, not only the lymphatic glands which are obviously enlarged, but also the whole lymphatic area, extending practically from the base of the skull to the episternal notch. It is obviously desirable to undertake such extensive operative proceedings in two stages, if possible, dealing first with the tumour in the month, and subsequently with the glands. The fact that recurrence is rarely noted in the portion of the organ that intervenes between the two operative areas indicates that such a practice, though not ideal, is justifiable.

In all cases great care must be taken in the preparation of the patient so as to minimize the risk of infective mischief. Suitable antiseptic mouth washes are employed for some days, dirty roots and stumps are removed, and the remaining teeth carefully scaled and tartar

removed. Possibly if time permit a culture might be made of the chief organisms in the mouth and a vaccine procured which may help to guard the patient from post operative infection. It is also wise to keep him indoors for a few days beforehand so as to protect him from risks of cold and bronchitis and to stop all smoking.

The actual operative details differ somewhat according to the extent and situation of the disease but most of the operations for removing the growth are a modification of the intrabuccal method suggested by Whitehead.

If the *tip* only is involved it can be removed by a V shaped incision made after steadying the tongue with a deep suture. The small ranine artery will spurt on each side but is easily secured and the gap is then closed by sutures.

When the disease involves one side of the tongue and is not very extensive and does not spread deeply into the base it will suffice to remove the *anterior half* or two thirds of the affected side as a first stage without touching the glands. The patient having been anæsthetized the mouth is opened with an efficient gag and anæsthesia is maintained by giving chloroform through a Junker's apparatus or ether by intratracheal insufflation. A good assistant is necessary in order to prevent blood entering the larynx small swabs or pieces of sponge held in smooth nosed long handled forceps or suitable sponge-holders being used to clear the pharynx. A coarse silk thread is passed through each half of the tongue to draw it forwards and steady it. The tongue being drawn out of the mouth by these loops of silk is carefully divided by blunt ended straight scissors down the middle line into two segments which are readily separated from one another by the finger the scissors merely dividing the mucous membrane. The base of the organ is freed by cutting through the mucous membrane close to the alveolus and then along the middle line of the floor of the mouth so that the sublingual salivary gland can be also taken away—a most necessary step. The blunt end of a curved pair of scissors is then pushed down behind the symphysis and the attachment of the genio-hyoglossus to the bone divided thereby enabling the tongue to be drawn out much more effectively. The mucous lining of the dorsum is now divided transversely behind the growth and the muscular structure of the organ slowly nipped through with scissors. During this process by the aid of the finger or a director the vessels can be seen and secured before division. Removal of the diseased half with the sublingual gland is thus easily accomplished by making the incisions meet and dividing the intervening tissues. Bleeding points are picked up and secured as they appear. It is always advisable to expedite healing by closing the wound in the tongue partially or entirely either by stitching the mucous membrane of the dorsum to that of the base or by twisting the half tongue on itself and stitching the tip to the back of the organ. The patient will probably be sufficiently recovered from this operation to enable the surgeon to deal with the glands in a week or ten days.

If both sides of the tongue are involved but the disease has not

extended deeply into the base it is not difficult to effect removal by a modification of the same procedure. The mouth is gaged open and two silk slings are inserted, one through the anterior portion and the other just in front of the epiglottis. The mucous membrane of the floor of the mouth is then incised on either side and the muscles attached to the genial tubercles divided. By this means the tongue is considerably loosened and can be drawn well up out of the mouth so as to enable the section to be made across it with scissors at the desired level. The main vessels can generally be seen and secured before division and the amount of bleeding is not excessive. It is often possible to draw forward the stump of the tongue and secure the mucous membrane anteriorly so as to diminish the size of the raw area in the mouth.

When the disease extends more deeply into the substance of the tongue and the organ is fixed operation is contra indicated and *trea-*

ment by radium should be adopted. In the past extensive mutilating operations were performed but these are not considered justifiable at the present day.

In dealing with growths arising in the posterior third of the tongue it is frequently found very difficult to insert radium needles and then radon seeds can be inserted by an introducer.

It is just as necessary in treating a case of carcinoma of the tongue with radium to eliminate oral sepsis by a scrupulous toilet of the mouth as suggested above. Local anaesthesia can be used but it is considered inadvisable as it

increases the amount of fluid in the tongue and radium does not react so well in oedematous tissues. For this reason intratracheal ether should be administered in these cases. When the patient is under the anaesthetic the surface of the tongue should be dried and the extent of the growth ascertained as accurately as possible. Radium needles containing 0.5 and 1.5 mg. are used they are inserted into the tongue around the growth about 1 cm. from each other. It is absolutely necessary that the needles should be completely buried otherwise areas of necrosis will occur. Each is secured by a double thread one end of which is passed through the substance of the tongue (see Figs. 587 and 588) and tied to the threads of the other needles thereby preventing them from shifting they are left *in situ* for seven or eight days. The dose varies between 800 to 1600 mg. hours. If radon seeds are used about eight to twelve seeds of 1.8 M.C. initial strength are

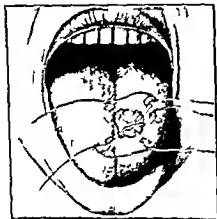


FIG. 55.—RADIUM NEEDLES INSERTED AROUND A GROWTH IN THE TONGUE

inserted and left *in situ* for ten days. In some cases a second application may be required (See also p 307)

The After-Treatment is much the same in all cases. The raw surface may be painted with Whitehead's varnish (which consists of Friar's balsam but with the rectified spirit replaced by a saturated solution of iodoform in ether) or with an oily solution of dichloramine-T. The all essential thing however is to keep the cavity well irrigated with antiseptic lotions such as weak solutions of boric acid boroglyceride (1 in 20) sanitas or lysoform and sprayed with dichloramine T from time to time. The patient must be closely watched for the first forty eight hours to see that his respiration is not obstructed by the stump of the tongue falling backwards but at the end of that time this danger will be at an end. It is not desirable to keep him in bed more than two or three days. The patient is fed *per rectum* for twenty four hours but afterwards a tube attached to the spout of a feeder is introduced into the pharynx or œsophagus. In the simpler cases he is able to swallow freely and without difficulty in the course of a day or two and even in the worst cases he can feed himself with a long tube passed into the pharynx in five or six days. The chief dangers of the operation arise from septic contamination resulting in secondary hæmorrhage or septic pneumonia and these are best avoided by careful and thorough preparation of the patient.

The removal of a part of the tongue is not such a mutilation physiologically as one might expect at first. Deglutition is interfered with for a time but the power is soon regained and even articulation may be in great measure restored.

The operation for removing the glandular area in connection with cancer of the tongue is a serious proceeding as its scope should extend from the mastoid process to the episternal notch. If the disease has involved both sides of the tongue both sides of the neck must be cleared and even when the disease has only apparently affected one side of the tongue the glands on both sides of the neck may be involved. The incision extends along the anterior border of the sterno mastoid throughout its whole length and a second incision meets it reaching from the chin to just below the great cornu of the hyoid bone. The flaps thus marked out are dissected up and turned forwards the platysma being included in them. The cellular tissue of the submental and submaxillary regions together with all lymphatic glands and the submaxillary salivary gland (except the deep process and duct) is dissected up from before backwards and turned back towards the main vessels. The internal jugular vein is then laid bare and all the lymphatic glands lying upon it are dissected upwards from below or downwards from above. All the cellular tissue of the anterior

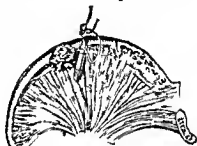


FIG 588.—METHOD OF INSERTING AND RETAINING A RADIUM NEEDLE IN THE TONGUE

triangle is cleared away in one piece with the glands extending from that which lies under cover of the omo-hyoid below to those which are placed beneath the posterior belly of the digastric and lower edge of the parotid above. The facial and lingual arteries will have to be secured back and front the external jugular vein is sacrificed and if need be the internal should also be taken away but the facial and spinal accessory nerves must be spared. Careful deep suturing will minimize the deformity but it will be necessary to drain the lower part of the wound.



FIG 589—COLUMBIA PASTE COLLAR APPLIED TO THE NECK

In cases where the primary growth has been treated with radium it is still necessary to remove the glands in the neck and frequently a bilateral dissection is required the sterno-mastoid muscle can be removed on both sides without giving rise to any disability.

About three or four weeks after the removal of the glands when the wound has soundly healed the neck may be irradiated with radium. Probably the best method is to apply a Columbia

paste* collar 15 mm. thick which should embrace both sides of the neck. Radium needles of 1.5 mg. are applied to the surface of the wax and kept in place by adhesive plaster (Fig 589). The total post-operative dose should be 10,000 mg. hours. To obtain this the collar will have to be worn about sixteen hours a day for two weeks. Even in cases where operation has been performed on the tongue and glands the cervical area may be treated in this fashion as an extra precaution against recurrence.

Affections of Salivary Glands

Inflammation of the Parotid Gland is met with in several different forms

1 Epidemic Parotitis (Mumps) is a highly infectious acute specific disease usually seen in children. The period of incubation is about three weeks and the attack itself consists in a slight febrile disturbance associated with swelling of one or both parotid glands, one gland is attacked first becoming enlarged and tender whilst the other side is similarly affected in a day or two. Mastication becomes difficult owing to the tension of the parts. The swelling usually persists for about a week and then gradually subsides it extends below and in front of the ear and the socia parotidis can be felt lying over the masseter the submaxillary, sublingual and neighbouring lymphatic glands are sometimes enlarged. Suppuration is rare but in adults metastatic inflammation of the testis, mamma or ovary is not un-

* Columbia paste—a wax consisting of beeswax, paraffin and sawdust.

common. This complication is generally unilateral and thus although atrophy of the testis commonly follows orchitis sterility is not produced. *Treatment*—Keep the patient warm and quiet and administer salines. In the later stages friction with stimulating liniments will hasten resolution. After an acute attack the gland may remain enlarged for some time.

2 A Simple Parotitis occasionally results from exposure to cold or from injury whilst the presence of a calculus in the duct leads to a chronic sclerosing inflammation. The symptoms consist of pain and swelling together with a certain amount of constitutional disturbance. Occasionally unilateral or bilateral parotitis may result from irritation of the gums and obstruction of the orifice of Stenson's duct by a large upper denture especially if the latter is rough and covered with debris due to lack of cleaning. Post-operative Parotitis was a fairly common complication of abdominal operations before it became known that the infection was a buccal one and reached the gland by the parotid duct. Today it is very rare since oral sepsis is always treated before any abdominal operation is contemplated. *Treatment* should be prompt incision and drainage being required. Incision should not be delayed until fluctuation can be elicited. It is only in the later stages that fluctuation can be made out and this is due to the fact that the parotid is encased in a very firm capsule derived from the cervical fascia and the texture of the gland is very firm. A \perp shaped incision should be made and the skin and parotid capsule incised the gland should then be explored with a pair of sinus forceps or a probe. A single \perp shaped incision is often sufficient but at times multiple incisions are necessary (Fig 590).



FIG 590—INCISIONS USED IN OPERATING UPON CASES OF SUPPURATIVE PAROTITIS

3 Suppurative Parotitis is a much more serious condition. It may extend from the mouth along Stenson's duct or supervene in the course of pyæmia or as a sequela of some of the exanthemata e.g. scarlet or typhoid fevers. The gland becomes enlarged with congestion and œdema of the overlying skin and owing to the tension of the fascia exceedingly painful. *Treatment*—If early incisions are not made into the gland the pus finds its way to the surface by bursting into the external auditory meatus at the junction of the osseous and cartilaginous portions. The gland itself undergoes necrosis and large sloughs are formed. The incisions illustrated in Fig 442 will be found very useful. Early free incisions are imperative mere puncture of the gland or probing it with sinus forceps is useless.

Inflammation of the submaxillary and sublingual glands may arise in an exactly similar way but no special description is called for. Occasionally however the process extends beyond the submaxillary glands to the neighbouring tissues giving rise to what has already been described as submaxillary cellulitis or Ludwig's angina.

Ranula is a cystic swelling of the floor of the mouth containing

a glairy mucoid fluid which is not saliva. There has been much controversy as to its origin, and the matter is as yet unsettled. It has been attributed to obstruction to Wharton's duct or to blocking of one



FIG. 391.—CALCULUS REMOVED FROM DUCT OF SUBMAXILLARY GLAND (ACTUAL SIZE)



FIG. 392.—CALCULUS REMOVED FROM DUCT OF SUBMAXILLARY GLAND

of the sublingual ducts (ducts of Rivini), but neither suggestion corresponds with observed facts. The most likely explanation is that it is due to distension of a displaced portion of a lateral dermoid of the neck. the cervical sinus remains unobliterated, and is carried forwards

by the extensive migration of the muscles that enter into the tongue. The tumour is usually unilateral, and may become as large as a pigeon's egg.

Treatment consists in complete extirpation, if possible, a careful search being made for any outlying projections or communicating tracks. Too often the cyst bursts during this procedure, and its limits being then lost, all the surgeon can do is to remove as much of it as possible by torsion or dissection, and to pack the cavity and allow it to heal by granulation.



FIG. 393.—SUBMAXILLARY GLAND WITH A CALCULUS EMBEDDED IN IT

Obstruction to the Flow of Saliva results from various causes, such as cicatricial contraction in the neighbourhood of the entrance of the duct into the mouth, or from the presence in the duct of a *salivary calculus*, consisting of phosphate and carbonate of lime, and usually

fusiform in shape (Figs 591-593). Calculus formation more frequently occurs in connection with the submaxillary and sublingual glands since the saliva secreted by them is thick and mucoid whereas parotid saliva is limpid in character. The majority of salivary calculi are opaque to the X rays (Fig 594).

The chief *Symptom* is a painful enlargement of the gland during and after meals gradually disappearing as the saliva finds its way past the block. In old standing cases the gland becomes chronically enlarged and its interstitial tissue increased in bulk whilst a certain amount of periadenitis also follows. When a calculus is present there is usually a considerable discharge of offensive mucus into the mouth. Where the obstruction is complete a cyst may form and if this is opened or finds its way to the exterior and bursts a salivary fistula results.

Treatment—In cases of simple obstruction an attempt must be made to restore the natural exit or to make an artificial one. A calculus can usually be seen or felt



FIG 594—SKIAGRAM SHOWING CALCULUS IN DUCT OF SUBMAXILLARY GLAND

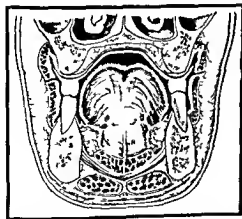


FIG 595—DIAGRAMMATIC DRAWING THROUGH THE MOUTH SHOWING THE RELATION OF AN UPPER DENTURE TO THE ORIFICES OF STENSEN'S DUCTS

at intervals projecting from the entrance of the duct which must then be incised from the mouth and the stone removed. If placed deeply in the substance of the submaxillary total removal of the gland should be performed (Fig 593).

Chronic Parotitis may follow irritation of the opening of the duct in the mouth by badly fitting dentures (Fig 595). Acute emphysema of the gland can occur in glass blowers, wind instrument players etc. and it has also been produced artificially by malingerers in war time. The emphysematous appearance may be alarming but it rapidly subsides in the course of a day.

Salivary Fistulae—Fistulae of the submaxillary gland are uncommon and all heal of their own accord. The rare cases which do not

easily treated by excision of the gland. Parotid fistulae are not very rare and may be divided into two groups according to whether they involve the duct or the gland.

Fistulae of the parotid gland and duct are most frequently caused by injury or by suppuration around a calculus. In operations for removal of glands from the upper part of the neck the lower part of the parotid may be wounded and a small fistula will result which generally heals almost at once unless the wound becomes infected when a permanent fistula invariably results. When the duct is involved the nearer the lesion is to the gland the more difficult it is to cure.

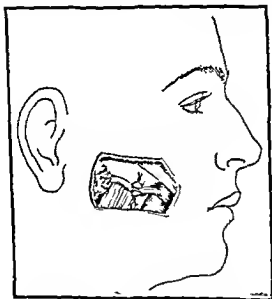


FIG 596—METHOD OF SUTURING THE PAROTID DUCT OVER A PIECE OF SILKWORM GUT

Spontaneous healing is unknown and the portion of the duct in front of the fistula frequently becomes stenosed and sometimes obliterated. Should the fistula be situated in front of the masseter operation will often cure. In recent cases such as a stab injury the wound should be opened up and the two ends of the duct isolated. A piece of stout silkworm gut is passed from the mouth through the orifice of Stenson's duct and out on to the face; it is then passed into the proximal portion of the duct and thus acts as a dowel (Fig 596). The wall of the duct is sutured over the piece of silkworm gut and the skin wound closed. In order to prevent a clot forming in the duct at the line of suture the silkworm gut is retained *in situ* until the patient recovers from the anæsthetic. This method is only of use when the wound is recent.

If in a recent case there is difficulty in getting apposition of the divided ends of the duct the proximal portion should be ligatured, in the absence of sepsis this will cause atrophy of the parotid. If however, infection is present septic parotitis will follow.

In old standing cases of pre masseteric fistula the following procedure will sometimes suffice. A straight needle threaded with silk is passed through the fistula into the mouth the needle is then unthreaded and the piece of silk outside the mouth is threaded on to it. The needle is then inserted through the fistula into the mouth a second time. The two ends of the silk are then tied in a knot. The included piece of tissue which is strangulated by the suture dies and sloughs and by this means an opening is made into the mouth. As the parotid secretion has now a free vent into the mouth the fistula heals (Fig 597).

Fistulae of the proximal portion of the parotid duct viz over the masseter muscle are as may be imagined very difficult to cure and nearly thirty different operations have been devised. There is however only one justifiable procedure an old one which has been much neglected. By means of a small fine malleable probe which is passed from the mouth along the duct and out of the fistula on to the face a piece of silk is attached and drawn out on the face. To the end of the silk is attached a fine piece of drainage tubing and this is drawn out of the fistula leaving one end in the mouth while the other is projecting on the face. Saliva may find its way along the side of the drainage-tube into the mouth. After a few days the drainage-tube is drawn so far into the mouth that it no longer projects from the fistula. Finally after a week it is withdrawn altogether. In some cases the result of this method is admirable and the fistula remains completely closed should infection of the duct be present however, the rubber tube may cause parotitis.

There is only one certain method of closing a fistula of Stenson's duct when sepsis is present, or when the operation has failed and that is by avulsion of the auriculo temporal nerve. This method was first advocated by Leriche some years ago. A vertical incision is made in front of the external auditory meatus when the nerve is



FIG 597—METHOD OF FORMING A NEW OPENING INTO THE MOUTH BY MEANS OF A SUTURE THROUGH THE BUCCAL MUCOUS MEMBRANE.

seen lying just beneath the superficial temporal artery. The nerve is divided with a knife the proximal portion grasped with a pair of Spencer Wells forceps and as much of it as possible avulsed by firm traction. The fistula is generally healed at the end of a week.

Fistulæ of the parotid gland as already mentioned usually heal of their own accord. For those which do not two methods of treatment are available

- (1) Radiotherapy and
- (2) Avulsion of the auriculo temporal nerve

Radiotherapy rarely fails to cure and is quite simple. 25 mg of radium are enclosed in a platinum iridium torpedo the thickness of

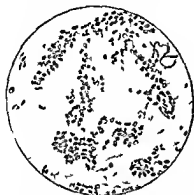


FIG. 508.—LOW POWER VIEW OF SECTION OF MIXED PAROTID TUMOUR SHOWING AREA RESEMBLING CARTILAGE.



FIG. 509.—HIGH POWER VIEW OF MIXED TUMOUR OF THE PAROTID SHOWING THE EPITHELIAL CELLS.

which is 0.5 mm. The torpedo itself is encased in another platinum tube 0.5 mm. in thickness in order that the β radiations may be cut off. The platinum tube is then placed in a rubber tube to facilitate its application. The fistula and its surrounding parts are covered with lint in order to cut off any secondary radiations from the metal filters. A four hour application is usually sufficient but should the skin be somewhat thickened and indurated from the constant discharge of saliva a six hour application is advisable. Whatever length of application is used it is advisable to give a hypodermic injection of atropine (gr. $\frac{1}{100}$) half an hour beforehand. This lessens the secretion of the gland during the time the radium is being applied.

X rays have been used in the treatment of parotid fistulæ but are not so constant in their action. Three pastille doses with a weekly interval between each should be given through a filter of 3 mm. aluminium. Here again the atropine should be administered prior to treatment.

Tumours of the Parotid Glands are of considerable interest and may be simple or malignant.

The commonest Simple parotid tumour is the so called *mixed tumour*, which is characterized by the presence of spaces containing material resembling cartilage. There has been, and still is, an active controversy as to the nature of these mixed tumours. They were at first thought to be purely epithelial in origin but Virchow suggested that the so called cartilage was formed by a process of metaplasia from connective tissue, whilst Cohnheim stated that it was a remnant of the branchial arches which became displaced during foetal life.

An endothelial origin was proposed by Wartmann, who considered that the polyhedral cells were derived from lining cells of the lymphatic vessels but it has now been demonstrated that the cells show no definite endothelial characters under the higher powers of the microscope and more modern and delicate contrast staining. At the present time the consensus of opinion is that the vast majority of so called



FIG 600 —SIMPLE PAROTID TUMOUR



FIG 601 —SIMPLE TUMOUR OF THE PAROTID GLAND (OPERATION SPECIMEN $\times \frac{1}{2}$)

mixed tumours are entirely epithelial in nature. They are derived most frequently from the ducts of the glands but in a few cases from the secreting cells. The mucinous material which is such a prominent feature of most of these tumours, is a true secretion of mucin from the tumour cells and is only an exaggeration of a normal function of the gland cells. In the substance which has been described as cartilage, the matrix is formed by a change in the mucin of the tumour, where it loses its fibrillar appearance and its power of staining deeply with special dyes (Figs 598, 599).

Clinical Features —Mixed tumours are equally common to either sex, and know no age incidence, they may occur in children or old people. They are usually situated in the superficial portion of the gland substance, are coarsely nodular, and vary in consistency in different parts (Fig 600). The facial nerve in its course through the gland is deeply placed and hence is not pressed on by these tumours unless they

undergo malignant change. They have a definite capsule and outside this the gland tissue is somewhat compressed to form an extra pseudo-capsule (Fig 601). This fact is important from the point of view of treatment for it permits of ready enucleation and fistula rarely results owing to the compressed gland substance around the tumour preventing any escape of secretion.

These tumours show a definite tendency to recur even after a long interval and therefore are considered by many surgeons to be potentially malignant.

Malignant tumours of the parotid (Fig 602) occur in the form of sarcoma or carcinoma and are sometimes secondary to a simple tumour the change of type being marked by increased rapidity of growth and greater pain. The mass becomes more fixed and signs of



FIG 602—MALIGNANT TUMOUR OF THE PAROTID

The drooping of the eyelid and general asymmetry of the face are indicative of the facial paralysis caused by the growth.



FIG 603—MIXED TUMOUR OF THE SUBMAXILLARY GLAND

The patient had noticed the tumour for eight years.

pressure upon the vessels and nerves develop the facial nerve is very likely to be implicated leading to paralysis of the face. Moreover the skin becomes hyperæmic and often adherent to the tumour and finally ulceration and even fungation may obtain. Secondary deposits occur in the neighbouring lymphatic glands or in the viscera and the patient soon passes into a state of malignant cachexia. Carcinomatous tumours are less common than the sarcomata but run a similar course. The growth is an adenoid cancer not unfrequently of the soft or encephaloid type and neighbouring lymphatic glands are early invaded.

The Diagnosis of simple parotid tumours from malignant growths is a matter of the greatest importance from a prognostic point of view, since simple tumours are usually encapsuled and their removal except when large or deeply placed is not a matter of special difficulty, malig

nant disease is more diffuse rendering extirpation of the mass almost impracticable. The distinction between the two forms is made by a consideration of the signs and symptoms considered above attention being directed to the rate of growth the condition of the skin and surrounding parts the mobility or not of the neoplasm and the general aspect of the patient whilst associated paralysis of the facial nerve is almost always characteristic of malignancy.

Treatment—Simple parotid tumours are dealt with by turning forwards or upwards a flap of skin and subcutaneous tissue, so as to expose completely the capsule and enable the dissection of the growth to be made with as little danger to the facial nerve as possible. It is generally placed beneath the growth but occasionally runs superficial

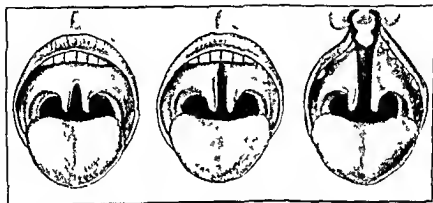


FIG. 604

FIG. 605

FIG. 606

VARIOUS FORMS OF CLEFT PALATE FIG. 604 INVOLVING MERELY THE VELUM FIG. 605 TRAVERSING THE HARD PALATE AS FAR FORWARDS AS THE ANTERIOR PALATINE CANAL AND FIG. 606 BEING COMPLICATED WITH A DOUBLE HARE LIP

to it, or in its substance. The tumour is often enucleated without much difficulty but the surgeon must make certain that no deeper processes are left, or recurrence will inevitably follow. The hæmorrhage from the transverse facial and other arteries is free but easily restrained. There is no need to remove redundant skin in these cases, as it quickly contracts.

Malignant tumours of the parotid cannot be treated by excision. Radium needles or radon seeds should be inserted into and around the tumour. If needles are used, about eight to ten 15 mg. needles are required according to the size of the growth, they are left *in situ* from six to eight days.

Tumours of the Submaxillary Gland are very similar in nature to those of the parotid. Simple tumours are represented by adenomata and mixed tumours (Fig. 603). Sarcoma and carcinoma are also met with, if seen in the early stages, they are easily removed.

Affections of the Palate

Cleft Palate—By cleft palate is meant a congenital defect of the roof of the mouth whereby the structures entering into its formation do not unite in the middle line, thus allowing an abnormal communication to exist between the nose and mouth. The term does not include losses of substance resulting from injury, syphilis or lupus. The mildest cases consist merely of a bifid uvula, perhaps not involving the palate at all; the next degree of severity affects the velum alone (Fig. 604), more or less of the hard palate may also be implicated, the cleft reaching as far forwards as the site of the anterior palatine canal (Fig. 605) whilst the severest type of the deformity extends in addition through the alveolus and upper lip on one or both sides, the os incisivum being in the latter case displaced forwards perhaps on the tip of the nose (Fig. 606). The union of the palatal segments takes place from before backwards so that it is very unusual to find the alveolar portion of the palate affected apart from the rest.

On looking carefully at a cleft palate the defect usually appears to be mesial but occasionally it seems as if a unilateral or bilateral fissure



FIG. 607.—DIAGRAM TO SHOW THE MODIFICATIONS OF CLEFT PALATE

existed. To understand such an occurrence it must be remembered that three anatomical elements unite in the middle line of the roof of the mouth: viz. the two palatal processes growing in horizontally from the maxillæ, one on each side, and the ethmo-vomerine septum projecting vertically downwards from under the surface of the fronto nasal process and base of the skull. All these should join together about the ninth or tenth week of intra uterine life. If, however, the palatal processes fail to reach the middle line, a median defect appears (Fig. 607 A) unless the ethmo-vomerine septum is so hypertrophied as to project between them when the appearance of a double cleft is produced (B). When only one division of the palate unites with the septum an apparently unilateral cleft results, most commonly the defect is on the left side, the vomer being attached to the right free edge, a left-sided alveolar hare-lip also complicating the case (C). In these cases the septum often slopes off so as to appear to be continuous with the palatal segment.

The width of the cleft and the slope of the segments vary greatly in different cases. The wider the cleft, the more unfavourable it is for treatment by operative means, and this is one of the arguments used

in favour of the removal of the intermaxilla in cases of double hare lip so as to allow of the approximation of the two maxillæ. As to the *slope* of the segments the more vertical they are the more favourable for operation, since the flaps of muco-periosteum easily meet in the middle line. When the palate is more horizontal, and like a Norman rather than a Gothic arch, the flaps are shorter and greater lateral displacement is necessary to bring their edges into apposition, this involves much more traction on the stitches, and hence less satisfactory results.

The *effect* of this deformity upon the infant, from a physiological point of view, is very serious. The process of *nutrition* is considerably impaired owing to the fact that the power of suction is lost, and fluids taken into the mouth are apt to escape through the nostrils instead of being swallowed. Consequently these children must be carefully spoon fed with the head thrown well back. *Articulation* becomes very indistinct so that it is often impossible to understand what is said, the voice having a peculiar and characteristic intonation. All the letters known as explosives whether dentals labials, or gutturals, requiring a certain amount of air pressure within the mouth for their due pronunciation, are difficult to produce, particularly *b, d, p, t, g, f* etc. Moreover, the exposure of the nasal mucous membrane to the air is so much greater than usual that it is liable to chronic rhinitis sicca (p. 916). Both taste and smell are much diminished partly from the unhealthy state of the mucous membrane and also from the absence of an opposing surface against which the food can be triturated by the tongue.

Treatment—The chief objects to be aimed at by the surgeon are (1) To provide a roof to the mouth, thereby protecting the nasal cavity from the presence of food and fluids. (2) to provide a movable velum so that the naso-pharynx may be cut off from the oro-pharynx during articulation and deglutition and (3) to secure these aims without disturbance of the mutual relations of the teeth of the two jaws, thereby protecting the patient from external deformity.

Langenbeck's operation aims at closing the whole cleft from front to back by raising flaps of muco-periosteum on either side, and drawing them together by sutures in the middle line. That it is capable of securing a satisfactory closure of most clefts of the palate, even when they are very extensive, cannot be doubted but at the same time the fact must be admitted that what is gained in transverse section is lost in antero-posterior, and that the functional activity of the velum is in all serious cases very greatly limited. Moreover, success in closing the gap in the hard palate introduces a fibro-cicatricial element into it which must result later on in drawing together the divided halves of the maxilla and thereby endangering the perfect occlusion of the teeth.

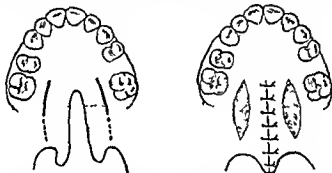
It is therefore wiser in the great majority of cases to provide a suitable obturator for the gap in the hard palate, but the gap in the velum may and should be closed by suitable operative proceedings. For this purpose *Langenbeck's* operation is in many cases quite satisfactory, but in others it is wiser to follow the proceedings suggested by Sir H.

Gillies whose work in this direction has been most admirable and has inspired what has been written above

The operation should be undertaken when the child is two or three years old. In younger children the parts are very small and the tissues very delicate and friable the operation is therefore increasingly difficult and the child is incapable of standing much shock or loss of blood. At the age named the patient is more readily controlled and bad habits of speech have not been formed. It is most important that the general health be good and the mouth and throat free from local disease or inflammation enlarged tonsils are usually removed previously. To guard against accidents it is well to keep the child indoors under observation for a few days previously and the spring and summer are the best time for the operation.

The closure of lesser defects of the palate may be carried out by Langenbeck's operation of *staphylorrhaphy* as follows.

Anæsthesia is induced by gas oxygen and ether the greatest care being taken to prevent the tissues being damaged by it. The child lies



FIGS 608 AND 609 — STAPHYLORRHAPHY (LANGENBECK'S METHOD)

on its back and the mouth is effectively gagged open. Incisions are made on either side reaching from the back of the hard palate to just in front of the cleft (Fig 608). Through these suitable raspatories are introduced and the palatal mucoperiosteum detached from the bone so that the front of the cleft is quite loose, it is also detached completely from the posterior border of the hard palate. The margins are then carefully but completely pared and it is easy to introduce stitches through the edges so as to bring them into accurate apposition (Fig 609). If there be any tension on the stitches the lateral openings are slightly and carefully enlarged backwards so as partly to divide the insertions of the levatores palati muscles.

Gillies' operation is more suitable in complete clefts of the palate. For details we must refer to larger textbooks but the essential elements are indicated in the accompanying diagrams (Figs. 610 and 611). The first step is to raise two short flaps of mucous membrane from the posterior end of the hard palate corresponding to its whole breadth and remaining attached to the velum. Next the velum is carefully but

completely detached from the back of the hard palate on either side so as to hang free. The short flap of mucous membrane is now rolled over the free border of the palatal segment and stitched in position, so as to prevent subsequent cicatricial contraction. The mucous membrane on the inner borders of the velum is then split longitudinally so as to free the upper and lower surfaces and without loss of tissue to provide raw edges for suturing together. Fine catgut stitches secure the palatal segments in position and thus a complete soft palate has been formed without attempting to deal with the hard. When healing is complete and the tissues have hardened sufficiently an obturator is provided by a dentist, and the patient is later handed over to a voice trainer.

After the operation the child should be put to bed with the head low so that any accumulation of blood or mucus may gravitate easily into the pharynx. The mouth can be washed out with a weak solution of sanitas, or sprayed with a solution of dichloramine T in chlormated eucalyptol. No nourishment should be given for the first four or five hours and but very sparingly for the first twenty four. Milk and



FIGS 610 AND 611—GILLIES OPERATION FOR COMPLETE CLEFT PALATE

In the former the necessary incisions are indicated in the latter the method of bringing the flaps together is shown so as to provide an effective velum the opening in front is covered over by an artificial obturator

water given by a spoon or from a feeder, will form the staple article of diet. By about the fifth day soft food, such as soaked bread and custard pudding, may be safely permitted. The patients are generally allowed up on the sixth day. The silver stitches may be left in for ten days or a fortnight without doing any harm. Should any signs of inflammation occur the palate should be sprayed over with a solution of peroxide of hydrogen.

It is possible that in most cases articulation will be, if anything, impaired as the immediate result of the operation, since the mechanism which the patient ordinarily employs is thrown out of gear, subsequent education at the hands of a voice-trainer is absolutely essential in order to correct this even then the unpleasant articulation occasionally persists.

Ulceration of the Palate occurs in a variety of forms *e.g.* (a) simple,

as an accompaniment of general stomatitis (b) *syphilitic* which may involve either the hard or soft palate if superficial it is usually a late secondary phenomenon if deep it involves the bones and often leads to necrosis and is then due to tertiary mischief (c) *lupoid* a somewhat uncommon condition which may result in great destruction of tissue it is usually seen in children and often associated with a similar disease of the nose from which indeed it may have spread (d) *tuberculous* due to the breaking down of a tuberculous abscess under the periosteum and then complicated with caries of the bony palate (e) *malignant* usually resulting from the growth of epithelioma either starting primarily in the palatal mucous membrane or extending to it from the tongue tonsil or upper jaw

Acquired Perforations of the Palate though occasionally caused by traumatism or lupus are in almost all cases due to tertiary syphilis. The ethmo vomerine septum is often involved in the destructive process giving rise to

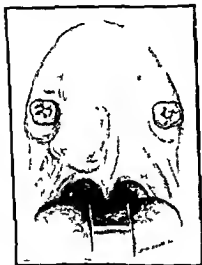


FIG 612—ADENOMA OF THE PALATE



FIG 613—SPECIMEN OF ADENOMA OF PALATE AFTER REMOVAL (NATURAL SIZE)

a most offensive discharge from the nose. If the soft palate is alone affected the velum may become fixed by cicatricial adhesions to the back of the pharynx and pharyngeal stenosis or considerable loss of substance of the velum results. A nasal intonation of the voice is always caused by any condition which interferes with the closure of the naso-pharynx by the velum during articulation. The treatment of these conditions should follow the usual antisymphilitic course. Perforations are best remedied by the use of plate obturators. We have seen our patients make efficient obturators out of a piece of sheet indiarubber maintained *in situ* by suction or of two pieces stitched together in the middle one piece passing above and the other below the opening. Occasionally when the aperture is

small, the local disease soundly cured, and the general health good, an attempt may be made to close it by stripping up muco periosteal flaps, paring the edges and suturing them together. The results are, however, seldom satisfactory.

Any of the ordinary forms of inflammation of bone may be met with in the hard palate. Necrosis is usually due to tertiary syphilis, or may accompany acute subperiosteal suppuration, extending from an alveolar abscess. In either case the surgeon must wait till the sequestrum is loose, and then it may be removed. Caries is generally due to syphilis or tubercle.

The following tumours occur on the *hard* palate. Simple *epulis* may extend from the alveolus, or an identical condition may start in the middle line. An *adenoma* (Figs 612 and 613) of the palatal glands is occasionally met with. It presents as a smooth or papillated tumour, somewhat resembling epithelioma, but distinguished from it by its slower rate of growth, and the absence of ulceration, pain, or glandular enlargement. An operation limited to the soft parts is probably all that is necessary. *Sarcoma* may be primary, and is then often myxo-sarcomatous in type, or secondary. In the former case it simulates rather closely a diffuse alveolar abscess, but is recognized by its slower growth, less pain, absence of inflammation, and, if need be, by the results of an exploratory puncture. *Epithelioma* also occurs but is uncommon. Treatment for the two latter conditions if limited to the palate, would consist in local removal, with a later operation on the glands, if necessary. Sarcomatous growths would be better treated by radium.

Elongation of the Uvula is frequently the result of a chronic relaxed throat. At first it merely lasts for a time, and by the use of astringents disappears, but later on the elongation becomes chronic, and causes great irritation of the back of the tongue and fauces, resulting in a troublesome throat cough and even vomiting. Under exceptional circumstances it should be removed. After well cocaineizing the part it is grasped by a pair of hook forceps, which seize not only the mucous membrane, but also the muscular structures beneath, and a sufficient amount is then removed by snipping it across near the base with a pair of blunt-ended scissors, leaving about a third of an inch of the organ behind.

CHAPTER XXXII

AFFECTIONS OF THE NOSE AND NASO PHARYNX

By V E NEGUS M.S. F.R.C.S.

Depression or flattening of the Bridge of the Nose may be caused by traumatism such as a fracture of the nasal bones (p 531) or may follow defective growth of the ethmo vomerine septum due to disease of syphilitic or tuberculous origin early in life or may result from tertiary syphilis. A common cause in childhood is abscess of the septum due to injury leading to necrosis of the septal cartilage and subsequent falling in of the bridge. In adults a falling in at the tip of the nose may be caused by too extensive removal of the front portion of the septal cartilage during the operation of submucous resection for septal deviations.



FIG 614.—EXPANSION OF BRIDGE OF NOSE (FROG NOSE) RESULTING FROM THE PRESENCE OF MUCOUS POLYPI

If the result of injury and dealt with promptly it may be remedied but when once acquired and especially if the consequence of disease treatment is more difficult. Good results may however be obtained by the introduction of a cartilage or bone graft obtained from a costal cartilage or a rib.

The subcutaneous injection of paraffin was tried for a time but although the immediate effect was good it did not persist. Certain dangers also were associated with the method.

Expansion of the Bridge of the Nose is always the outcome of some long-continued intranasal pressure.

It follows the development of mucous polypi when they are very large and chronic. The bridge is flattened and bulged out on either side giving the face an appearance justifying the name frog nose (Fig 614) which has been applied to it.

Congenital swellings at the root of the nose may be either a meningocele or a dermoid cyst which may have a deep connection between the nasal bones with the cerebral membranes. It is often advisable to leave them alone until adult life since the intracranial connections may be shut off as the child grows up.

It is impossible to discuss all the different affections of the skin of the nose. Many of them are associated with the sebaceous glands which in this region are very large and abundant. Thus *acne* is commonly met with arising from an inflammation of the glands after obstruction to their ducts. It is especially frequent in drinkers and dyspeptics women addicted to tea drinking often suffering severely. When the superficial capillaries become markedly dilated and the face readily flushes after drinking hot or stimulating fluids the term *rosacea* is attached to it. Sometimes the spots become much enlarged and there is a considerable amount of infiltration of the base a condition described as *acne hypertrophica*. In the most exaggerated stage the sebaceous glands become overgrown and form large protuberant nodular masses projecting from the end of the nose and covered with red greasy skin in which the dilated orifices of the glands are very evident and with dilated capillaries coursing freely over them. This condition is generally known as *lipoma nasi rhinophyma* or *hammer nose* (Fig 615). The Treatment



FIG 615 —RHINOPHYMA OR HAMMER NOSE



FIG 616 —EPITHELIOMA OF NOSE

of simple *acne* consists in correcting the dyspepsia and limiting the amount of or interdicting entirely alcohol or tea. Capsules of ichthyol (3 to 10 minims) may also be administered thrice daily and soothing applications should be used locally such as a lotion consisting of calamine oxide of zinc and precipitated sulphur held in suspension with glycerine and lime water. Dilated and unsightly capillaries may be dealt with by puncturing them with the galvanic cautery or an electrolytic needle.

Rhinophyma may be checked in its incipient stages by the judicious use of X rays when fully developed operative treatment is required. The best procedure is to shave away the

exuberant masses with a razor or scalpel. The islands of epithelium left at the extremities of the sebaceous pits rapidly spread over the raw surface. Great care must be taken to avoid opening into the nasal cavity and a finger in the nostril is probably the best precautionary

measure to use as a guide during the shaving process. Hemorrhage is free but is readily checked by iced saline compresses and pressure dressings. Diathermy coagulation is useful for persistently bleeding points. Only occasionally is it necessary to skin graft the raw surface left by the shaving process.

Partial or Total Destruction of the nose may result from disease or trauma or may be the necessary end-result of the eradication of the former. Lupus tertiary, syphilis, epithelioma (Fig. 616) and rodent ulcer amongst diseases, and gunshot wounds and motor accidents amongst traumata are the most common causes. Many methods of Rhinoplasty have been devised but only one will be described.

The so-called *Indian Method* employs for the reconstruction of the nose a flap of skin from the forehead and is for most cases the method of choice. The flap is more or less pyriform and has its pedicle based on the supra-orbital vessels. Occasionally the pedicle is so arranged as to contain the superficial temporal vessels. The construction of a nose calls for the supply of lining and framework in addition to covering skin. Without supporting thickness the nose will be flat and featureless; if no lining is provided the deep surface of the flap will heal by granulation and cicatricial contraction will spoil the result. Keegan, who did much of the pioneer work in this sphere, advised that the skin covering the nasal bones as high as the level where the bridge of spectacles would rest should be turned down as a flap, using its fusion with the nasal mucosa as a hinge with its epithelial surface inwards and its raw surface outwards.

If skin is not available in this region similarly hinged flaps may be obtained from the skin of the cheeks bordering on the lateral margins of the defect. Occasionally no healthy skin is available locally for this purpose and the forehead flap must be raised and its deep surface grafted by a free skin graft prior to its transfer to the nose. The modern trend is to depend more and more on the forehead flap itself for both lining and covering, its distal portion being folded inwards to supply lining material. Formerly it was customary to insert pieces of costal cartilage trimmed to suitable shape and size under the skin destined to provide either the lining or the covering of the new nose some days prior to the reconstruction. Nowadays the provision of support is usually left for a final stage in the reconstruction and a hinged cartilage graft inserted through one of the scar lines already present after suitable undermining of the covering skin gives good definition to the bridge line and satisfactory protrusion to the tip.

The forehead flap should be cut a little over-size for some shrinkage usually takes place. It should lie in its new position without tension and without kinking of its pedicle lest necrosis of its more distal parts be produced by interference with their blood supply. The new columella is particularly liable to suffer in this way.

No attempt is made at the time of transfer of the forehead flap to close the raw surface left on the forehead, approximation by sutures or the pressure dressing required to ensure the take of a free skin graft are liable to interfere with the all important blood-supply of the flap.

Sutures should be removed as early as possible if stitch marks are to be avoided and all should be out by the fifth day after operation. Drainage tubes may be inserted in the nostrils to preserve their shape and prevent hæmatoma formation between the covering and lining skin but it should be realized that such measures are useless for preventing the contraction of insufficiently skin lined openings.

The pedicle of the forehead flap is divided and replaced in ten to fourteen days. Delay in carrying out this stage has no adverse effect on the cosmetic result but renders the opening out and spreading of the pedicle on the forehead a much more troublesome procedure.

The raw surface which remains may be covered immediately by a Thiersch graft or may be left for a further week or so until the pedicle has settled in to be covered by a free full thickness graft which provides skin of better texture and appearance.

Although when circumstances dictate it very unobtrusive prosthetic appliances of suitably coloured metal or other material can be made and held in position by adhesives or by a spectacle frame a nose which is essentially part of the patient's own body is infinitely preferable and more satisfactory in every way.

Examination of the Nasal Fossæ and Naso Pharynx—In order to understand fully the diseases of the nose it is essential that the interior of the organ be efficiently examined and to do this four chief methods are employed.

1 *Anterior rhinoscopy* consists in the illumination of the front of the nasal cavity through the anterior nares. A good light is required either reflected from a frontal mirror or derived from an electric head lamp and some form of nasal speculum. Thudichum's speculum is one of the best it consists of two unfenestrated blades connected by a U shaped spring which is held in the hand whilst the blades are inserted into the nostril the nasal vibrissæ being thus held aside the ring and index fingers are placed one on each limb so as to regulate the amount of tension and prevent painful overstretching. By this or similar means one is enabled to see the anterior part of the nasal fossæ including the inferior turbinal and the erectile tissue at its anterior extremity. The amount of distension of the latter limits the view of other structures if greatly swollen it feels soft and even fluctuating but collapses entirely on the application of a 2½ per cent solution of cocaine allowing the free convex border of the middle turbinal to come into view as also the cleft or olfactory fissure between it and the septum. The septum can also be examined frequently showing deviations from the middle line and thickenings or spurs of bone or cartilage which run in an antero posterior or vertical direction. A certain amount of erectile tissue is also present on the septum.

The introduction of a sterilized probe under the guidance of the eye is of the greatest value in examining the nose.

2 By *posterior rhinoscopy* is meant an examination of the posterior nares by a mirror placed behind the uvula and soft palate. It is by no means easy to accomplish and requires some dexterity and practice. The tongue should be depressed and a small mirror the glass surface of which is previously warmed to prevent condensation of moisture is

then passed behind the uvula without touching it or the posterior wall of the pharynx and by shifting its angle and position a view should be obtained of the structures exposed. If not successful and if it is absolutely necessary to obtain a view the fauces should be cocaineized and the velum held up by some form of palate retractor such as White's. The posterior nares (or choanæ) are seen separated by the posterior free margin of the septum and within each cavity the rounded ends of the turbinals with the meatuses intervening. The inferior meatus often looks very small owing to the prominence of the velum palati whilst the middle meatus may be encroached on by tumefaction of the erectile tissue at the back of the inferior spongy bone. Lateral to the choanæ are seen the yellowish openings of the Eustachian tubes and above and between them Luschka's tonsil a collection of lymphoid tissue in the roof of the naso-pharynx which forms adenoids when enlarged may in some patients be observed.

3 *Palpation of the Posterior Nares* with the index finger previously disinfected is rarely necessary. Standing behind with the head held firmly the left cheek is pushed in between the molar teeth with the left forefinger to save being bitten the index finger of the right hand is then passed behind the uvula and velum and the nares can be explored and the existence of adenoids or other growths determined.

4 A bacteriological examination of the discharge from the nose is often of the greatest value especially when a recurring nasal catarrh is present. Swabs from the nasal fossæ are usually sterile and it may be necessary therefore to take them from the nasopharynx. Various forms of bacteria are found and a vaccine will often protect the patient for a considerable time. The meningococcus may sometimes effect a lodgment in the nasal fossæ without the patient experiencing any ill-effect as also the *B. diphtheriæ* and carriers of these organisms may scatter infection widely.

5 Finally *transillumination* and a radiographic examination may be of considerable service.

Spurs and Deviations of the Nasal Septum—By the term *spur* is meant a cartilaginous or bony ridge or thickening of the septum which runs in a more or less oblique direction. A *deviation* is a bending of the septum from the middle line causing inequality of the nasal fossæ the cartilaginous septum is mainly involved and the condition is sometimes of traumatic origin. The two conditions are usually combined and when they are not the outcome of an injury a high arched palate is usually present. They give rise to nasal obstruction associated with chronic rhinitis. Attacks of paroxysmal sneezing of the hay fever type may result from these defects. Nasal asymmetry is visible in most cases of deviated septum due to injury. To correct deviations with or without spurs or ridges submucous resection of the septum is performed under a local or general anæsthetic and the results are excellent. The muco-perichondrium and muco-periosteum are stripped up on the convex side and the whole thickness of the cartilage and bone is removed the two layers are then placed in contact and by their union constitute a median septum.

Foreign Bodies are sometimes impacted in the nasal passages of

children Any unilateral purulent discharge from a child's nose should suggest the likelihood of such an occurrence, peas beads, or buttons being the substances usually introduced A certain amount of unilateral obstruction to nasal respiration is caused thereby, followed by a catarrhal or even suppurative rhinitis and in old standing cases a rhinolith or nasal calculus may be formed by the deposit of inspissated mucus upon the outer surface of a foreign body Removal is best effected by thoroughly cocainizing the affected side so as to reduce the congestion and swelling of the mucous membrane, and then seizing the foreign body by suitable forceps a hook or a snare For children a general anæsthetic is required Removal should never be attempted without the assistance of frontal illumination and a nasal speculum Necessarily all instruments used for this purpose should be thoroughly sterilized The old fashioned plan of attempting removal by syringing is most unsatisfactory and, indeed dangerous and should be totally discarded

Epistaxis, or bleeding from the nose, may arise from a variety of causes, including traumatism directed either to the mucous membranes or the bones or from the presence of ulceration or tumours Some of these local causes are very evident if only they are carefully looked for with a speculum and frontal mirror One of the commonest lesions is a small abrasion or ulcer of the septum, due to detachment by the finger of a scab or dried crust of mucus which causes irritation within the nostril, each time the nose is 'picked' in this way, bleeding recurs Another frequent source

of epistaxis is the rupture of a varicose vein in the mucous membrane of the septum, varix occurs not unusually in plethoric individuals, and sneezing or blowing the nose violently may lead to an attack Foreign bodies may cause hæmorrhage, as also ulceration of an angioma on the septum It frequently occurs in young people about puberty in consequence of local disturbance in the vascular arrangement of the parts, again, cerebral congestion may induce it, owing to the communication by means of emissary veins between the interior of the skull and the venous plexuses in the nose, excessive changes in the atmospheric pressure, as in mountaineering, may lead to epistaxis, whilst in abnormal states of the blood it may be associated with hæmorrhage elsewhere, as in hæmophilia, purpura, and scurvy. It is sometimes an evidence of chronic Bright's disease, and may be one of the first symptoms to call attention to the existence of this disease, it may follow cardiac or pulmonary disease, resulting in cerebral congestion, and may be a prominent symptom in enteric fever. One or

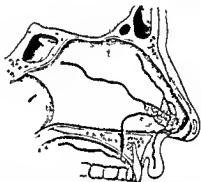


FIG 617 — BLOOD SUPPLY OF THE NASAL SEPTUM TO SHOW THE ANASTOMOSIS IN AN AREA CLOSE BEHIND THE NASAL VESTIBULE THE BLEEDING AREA

both nostrils may be the seat of the bleeding and it may be so excessive as even to threaten life.

Treatment—It must not be forgotten that in the majority of cases there is some local cause of epistaxis which can be found and treated directly. The bleeding is generally unilateral and in nine out of ten cases the source is within easy reach of the anterior nares being placed on the septum in the vestibule of the nose so that on grasping the nostrils firmly the ala is pressed against the bleeding point and the hæmorrhage is controlled and an opportunity given for clotting. At the same time the patient should sit up and cold be applied to the root of the nose or to the nape of the neck. If on examination the bleeding point is detected whether it be a varicose vein or an ulcerated surface the hæmorrhage can almost at once be stayed by applying a pointed galvano-cautery or by sealing the spot with a swab soaked in a solution of chromic acid (5 per cent) or adrenalin. Failing these measures the nostril may need to be plugged but such a proceeding is seldom required. It may suffice merely to pack the anterior nares with ribbon gauze soaked in soft paraffin or a sterilized rubber finger stall may be introduced and filled with gauze. If this does not suffice, the posterior nares must also be plugged. For this purpose Bellocq's sound is usually employed in order to pass a thread round the base of the palate and out of both nose and mouth, but where it is not obtainable a rubber catheter may be used instead. To the lower end of this thread or catheter a pledget of sterilized gauze soaked in iodoform about $1\frac{1}{2}$ inches by 1 inch in size is attached and this guided by the finger round the soft palate is drawn tightly forwards into the posterior nares. It is a good plan to have two threads coming forwards out of the nose and these may be tied firmly around a pad of lint placed over the side of the nostril thereby occluding the anterior nares and completely blocking the nasal cavity back and front. The loose end of the thread emerging from the mouth is fixed to the cheek by a strip of adhesive plaster. The plug is retained for twelve or even twenty four hours and then removed being replaced if necessary.

Inflammatory Diseases

Acute Rhinitis—This condition is extremely common constituting what is popularly known as a cold in the head. It is not only due to exposure to cold but may be caused by irritating gases or dust and may be one of the prodromal symptoms of influenza scarlet fever measles whooping-cough or glanders. Not only is the nasal mucosa involved but the inflammation often extends to the frontal or maxillary sinuses causing brow ache and face ache whilst if it spreads to the mucous lining of the Eustachian tube temporary deafness may ensue. Anosmia and partial loss of taste may be present. In infants great dyspnoea often results owing to the extreme narrowness of the nasal passages and this may be so marked as to interfere for a time with breast feeding. Apart from the usual domestic remedies directed to increasing the action of the bowels kidneys and skin, considerable

relief can often be obtained by steam inhalations containing Friar's balsam, menthol, and eucalyptus oil every three or four hours.

A suppurative form arises as a result of acute suppuration in one or more of the accessory sinuses, and then treatment must be directed mainly to the sinus. The discharge is abundant and causes much obstruction to nasal respiration in association with the marked swelling of the mucous membrane which is always present. The nasal passages must be cleared with steam inhalations, but nasal douches must never be used because of the danger of infecting the middle ear.

Chronic Rhinitis occurs in many distinct types of which we can merely give a bare outline.

1 **Simple Chronic Rhinitis** occurs most often in those working in a dusty atmosphere, and is often associated with inequality of the two nasal fossæ due to deviation of the nasal septum, it may remain after the subsidence of an acute attack. The mucous membrane is seen to be redder than usual, and is slightly thickened, thus giving rise to nasal obstruction. Search must be made for a cause in any of the nasal sinuses or in the naso-pharynx where adenoids may be present. Locally sprays of menthol in oil or of chlorotone and glycerine in cinnamon water are useful, the most important point, however, is to discover and remove the cause.

2 **Hypertrophic Rhinitis**, one of the most common forms is characterised by engorgement of the erectile tissue covering the inferior or middle turbinated bones, causing obstruction to nasal respiration and an abundant discharge of mucus. The entire nasal mucosa, septal as well as turbinal, may be involved. It usually occurs in male patients with prominent noses, where the passages are narrow, it may run in families, and is often present in Jews, it occurs with marked septal deviations on the concave side, closing up a roomy nostril and may be lighted up by some slight local irritant, such as a sudden change of temperature. It is frequently associated with and aggravated by infection of one or more of the paranasal air sinuses, careful examination and treatment of which must be carried out. The posterior end of the inferior turbinal is chiefly involved, it is swollen, red, and rounded the mucous covering being cedematous. The local application of a 5 per cent solution of cocaine causes its complete, though temporary, collapse in a few moments. If it is allowed to persist, hyperplasia of the mucous membrane follows, and in the most marked types a projecting papillomatous like mass results, this condition is often termed *morfiform enlargement* from its likeness to a mulberry. It is, however, merely an inflammatory hyperplasia, and not a new growth. The mucous covering of the middle turbinal may participate in the same process. A certain amount of pharyngitis or laryngo-tracheitis may also be present. **Treatment**—In the early stages all that is required is the use of steam inhalations of menthol and benzoin, or a spray containing menthol in oil, or chlorotone and glycerine in cinnamon water. If this is insufficient to give relief on account of permanent thickening of mucous and submucous tissues, a point of galvano-cautery at a red heat may be run along the length of the inferior turbinal bone.

In certain cases actual hyperplasia of parts of the nasal mucous

membrane takes place with great obstruction to respiration, it is often associated with the formation of polyp.

Straightening of the nasal septum or removal of part of the middle turbinal body may be necessary. The posterior end of the inferior turbinal may be snared but the main part of this structure must not be removed.

Nasal Polypi are inflammatory formations resulting from long standing rhinitis of the hyperplastic type, they consist of soft gelatinous masses which on microscopic examination much resemble myxomatous tissue, covered by ciliated columnar epithelium. They are usually associated with a secondary chronic osteitis of the underlying bone.



FIG 618—Mucous Polypi of Nose (Diagrammatic)

Translucent smooth pale nasal polypi are seen hanging in the nasal fossa. One originates in the frontal sinus and lies under cover of the middle turbinal body in close proximity to one arising from an anterior ethmoidal cell. Posteriorly one has escaped from the sphenoid sinus and another from a posterior ethmoidal cell. There is also commencement of polypus formation on the lower border of the middle turbinal.

They are often dependent on suppurative of the adjacent sinuses, especially the ethmoidal but the pus production may be secondary and not causative. Polypi are usually situated above or below the middle turbinal, arising from the lower border of the middle turbinal or from the ethmoidal cells. They rarely start from the roof of the nasal fossa occasionally in other sinuses or at the orifices leading into them, they do not involve the septum or inferior turbinal. Polypi are generally multiple (Fig 618), a large one projecting downwards and forwards towards the anterior nares and covering or hiding a series of smaller ones, which readily spring into prominence when that in front is removed. They are usually attached by a small pedicle and when developing in the nasal fossa are pyriform and laterally compressed. When of large size they may cause expansion of the bridge of the nose (Fig 614) and even protrude through the nostrils and then the epithelium covering the anterior portion becomes squamous and the mass firmer in texture and papillomatous in appearance. A special term *antro-choanal polyp*, is applied to one usually single and of large size when recognized, which springs from inside the maxillary antrum passes through the antral opening and travels backwards into the posterior choana and naso-pharynx.

The main symptom arising from nasal polypi is obstruction to the passage of air along one or both sides of the nose. This is always of gradual onset and invariably worse in wet weather, on account of the hygroscopic property of mucoid tissue. There is often a thin, watery

discharge from the nose. The patient is unable to blow the nose and his articulation becomes nasal in quality. Ill defined headache is common and due to the more or less complete obstruction of the nasal openings of the frontal sinuses. On rhinoscopic examination one finds a greyish semi translucent glistening mass occupying the nostril and attempts to blow the nose render this more obvious. Its pedunculated nature can be easily demonstrated by passing a probe around it.

The Diagnosis should present no difficulty to one who knows how to employ the nasal speculum. Abscess a spur or a deviation of the septum though causing unilateral obstruction can be recognized by the exercise of a very small amount of intelligence. Oedematous masses of granulation tissue associated with tuberculous or syphilitic disease of the bones are recognized by involving the septum as well as the turbinals by the absence of superficial epithelium and by not being distinctly pedunculated. Carious bone can often be felt by a probe through the granulation tissue. Polypi differ from hypertrophy of the mucous membrane over the inferior turbinated bone they do not spring from this region whilst the latter condition is sessile and red and shrinks considerably on the application of cocaine. They are distinguished from malignant new growths by their pale colour smooth surface and avascularity.

The Treatment of mucous polypi consists in their removal either by the snare or the curette.

The snare is specially indicated if there is a single polypus hanging down the naso pharynx or if the polypi are few in number. The patient is seated in a chair and the surgeon sits or stands in front. The nasal cavities are anæsthetized with a solution of equal parts of cocaine (10 per cent) and adrenalin and the situation of the pedicle ascertained if possible by inspection and by the use of a probe. The snare is then introduced and the loop passed round the base of the pedicle and gradually tightened. The polyp is then torn away and often brings with it the area of carious bone which lies beneath it. The same process is repeated to the smaller masses until the nose is clear. The cavity should never be tightly plugged afterwards for hæmorrhage unless the latter is very severe as meningitis may arise from infection passing up through the cribriform plate.

Where many polypi exist or if recurrence has occurred after the removal by the snare the nostril must be effectively cleared and the polypi and underlying bone removed for the cure of the underlying ethmoidal trouble. Radical ethmoidectomy is often desirable in the first place. Antrostomy also may be required.

3 Rhinitis Sicca is a condition characterized by loss of vascularity and deficiency of secretion from the glands of the nasal mucous membrane. It is found in those who work in hot and dry rooms and is treated by the application of oily solutions or of a stimulating paint such as that of Mandl (iodine and potassium iodide).

4 Atrophic Rhinitis generally commences in childhood and usually in an underfed child who may be debilitated by tuberculosis or may be the subject of congenital syphilis. It is a condition due to deficiency of blood supply and to diminution in the supply of and vis

cosity in the quality of the nasal mucus. It may follow in the train of hypertrophic rhinitis because of contraction in the chronically inflamed submucous tissues. When severe it is characterized by an exceedingly evil smell due to saprophytic decomposition of crusts when this occurs a condition of *ozæna* is said to be present. Some cases are caused by infection of the maxillary sinuses a thorough examination of which must be made. It must be carefully distinguished from the offensive condition due to tuberculous or syphilitic disease of the turbinated bodies or of the septum the impaction of foreign bodies or the ulceration of malignant growths.

The erectile tissue is collapsed and the ciliated epithelium may be lost in places or may be replaced by stratified epithelium. What secretion there is dries on the surface of the mucous membrane and gives to it a glazed appearance. The nasal fossæ are roomy because of shrinking of the mucosa and sometimes because of atrophy of the nasal turbinate bodies. Usually both sides are involved but occasionally one nasal fossa only is affected if the condition arises in a nose in which the septum is deflected. It is on the roomy side that the changes are first seen while on the narrow side there may be hypertrophy or hyperplasia.

The pharyngeal wall is often dry and crusted and the larynx and trachea may present the same appearances.

True *ozæna* is usually met with in young females and may sometimes commence after one of the exanthemata. The lips are often thick and everted and the mouth is usually held open owing to the impediment to nasal respiration caused by inspissated mucus. The factor of the breath due to the decomposition of this discharge is the special feature that calls attention to the complaint. It is peculiarly searching and objectionable but the patient fortunately is rarely cognizant of it. There is not much discharge but at varying periods large crusts come away giving relief both to the nasal respiration and to the factor. The disease lasts for many years but in time tends to improve and symptoms gradually disappear.

Treatment—The first essential is to keep the nose clean and free from putrefying masses of dried secretion. This must sometimes be accomplished by irrigating the cavity once or twice daily with a warm solution of sodium chloride, sodium bicarbonate and phenol. At first it is well for the surgeon to see to the cleansing himself but after a while the patient or her friends can be entrusted with the task. Every portion of scab ought to be removed daily and the surface lubricated with some such application as a spray of menthol and paroline (5 grains to 1 ounce) preceded by a spray of glucose and glycerine. The nose if severely affected may be plugged with a tampon of cotton wool medicated with some antiseptic preferably protargol (10 per cent) or argyrol (10 per cent). By these means a flow of mucus from the membrane is determined and the discharge is thus rendered more fluid and inspissation prevented. The general health must be attended to and patience and perseverance will generally be crowned with success. If the condition is unilateral and is associated with deviation of the nasal septum submucous resection may effect a cure.

Various means of narrowing the nose have been devised with success in some cases. Operative measures however are seldom required except for the treatment of an infected maxillary sinus if the latter is infected.

5 **Diphtheria** occurs in the nasal fossæ usually as a complication of the same disease elsewhere and requiring a similar form of treatment (p. 130). It may also occur as a local and non-systemic condition rendering the subject a carrier.

6 **Syphilitic Disease of the nasal fossæ** is generally tertiary in type and consists in a diffuse gummatous affection of the nasal bones, septum and turbinates with resultant suppuration and either cysts or necrosis. The condition is usually a very offensive one but the accessory sinuses are not specially liable to involvement. *Treatment* is of the usual antisyphilitic type including the injection of arsenic or bismuth preparations and perhaps the use of iodides and mercury. Locally the nose must be kept clean by irrigation and diseased bone removed. It is probable that if the septum is seriously affected the bridge of the nose will become depressed.

7 **Tuberculosis of the Nose** takes the form of lupus commencing typically at the junction of skin and mucous membrane in the vestibule. Jelly-like nodules appear which ulcerate and coalesce leading to destruction of the nasal septum with the formation of a perforation. The disease spreads both along the cartilages and also outwards to the skin of the face with signs of healing in places and contraction. Loss of tissue and contraction produce deformity and falling in of the tip of the nose. Secondary deposits may appear in the palate, fauces or larynx. A more active form of tuberculosis sometimes occurs with destruction of parts of the bony septum but never with perforation of the hard palate as in syphilis.

Treatment is directed to the removal of the focus by diathermy. General treatment is given to improve the health preferably in a sanatorium. Ultra-violet radiation gives good results in some cases.

Simple New Growths occur in the nose in the form of papilloma, fibroma, angioma, osteoma and chondroma. They may be removed if small through the nostril but if large Murrel's lateral rhinotomy or Roux's or Denker's operations may be necessary (see p. 937). (I or malignant disease of the nose see p. 984.)

Disease of the Accessory Sinuses of the Nose is a frequent accompaniment of either the acute or chronic nasal affections just passed under review or it may arise from more localized lesions e.g. antral trouble from affections of the teeth or frontal sinus infection from external injury. Perhaps the most common cause is a sharp influenzal attack which may lead to involvement of the nasal fossæ and all the sinuses (the so-called pan-sinusitis); this is tolerably amenable to treatment in the early stages but if neglected may become chronic and then serious trouble may result. There is then persistent discharge of purulent material from the nose which when arising from a maxillary antrum infected by a septic tooth root is often offensive and wrongly termed *ozæna*; to this may be added special features according to the particular sinuses which are mainly affected.

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It must be remembered that the outlet of some of the sinuses (Fig 619) is badly placed for drainage purposes, especially the maxillary antrum, the opening of which is nearer the roof than the floor drainage being maintained by ciliary action. Even in the case of the frontal sinus the outlet which is well situated for drainage is a long narrow passage easily blocked by *œdematous swelling of the mucous lining*. When once suppuration has commenced in the sinuses it may spread from one to another owing to the close proximity of the various orifices. The maxillary sinus is most frequently infected with the ethmoidal cells next in order. Infection of the frontal sinus is more rare and is almost invariably secondary to infection of the maxillary sinus.

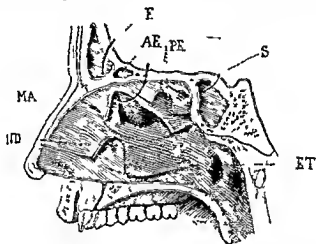


FIG 619—OUTER WALL OF NASAL FOSSA INDICATING THE POSITION OF THE ACCESSORY SINUSES AND OF THEIR ORIFICES.

- F Probe passed from frontal sinus down the infundibulum to middle meatus
 AE anterior ethmoidal cells PE orifices of posterior ethmoidal in superior meatus shown by removal of a portion of the superior turbinal S sphenoidal sinus with probe in its orifice MA orifice of maxillary antrum shown by cutting away part of the middle turbinal ND orifice of nasal duct under cover of the inferior turbinal part of which has been removed ET pharyngeal opening of Eustachian tube

In the more *acute* cases which follow influenza or cold the antrum and frontal sinus are most frequently involved. Readers are referred back to what has already been written on these subjects (p 988) with the emphatic reminder that careful treatment during the early stages may prevent the affection becoming chronic and save the patient from much suffering and danger. In the early *acute* stages irrigation of the nasal fossa should never be ordered but medication by means of steam inhalations the antrum may need washings out after cocaineizing the inferior meatus and puncturing the wall with trocar and cannula daily if necessary. Any more extensive operation is extremely dangerous in the acute stage and should be avoided for at least ten

days from the commencement of the disease, except in rare cases (see p 999)

In *chronic* cases the discharge will be found to come from one or both sides of the nose, and the patient will complain of feeling stuffed up, breathing will be mainly oral, and the breath is likely to become offensive. On examining the interior of the nose, even after cleansing it, the cavity is not found to be patent as in *ozæna*, but may be blocked up by swollen turbinals or by polypoid masses, which project mainly from the middle meatus. Pus may be seen lying in this region and comes from either frontal sinus, maxillary antrum, or anterior ethmoid cells.

In such a case the antrum should be punctured and thoroughly washed out, if afterwards more pus appears on hanging down the head, it must come from the frontal sinus or ethmoidal cells. The frontal sinus can, under certain circumstances, be catheterized and washed out without much difficulty, if pus still appears in the middle meatus, it must be derived from the anterior ethmoidal cells. Pus lying above the middle turbinal comes from the posterior ethmoidal cells or the sphenoidal sinus.

Affections of the Antrum,

The antrum of Highmore or maxillary sinus is a cavity lying within the superior maxilla, which is of much interest to the surgeon, it is roughly pyramidal in form and triangular on section. The bony walls vary much in thickness, but the orbital nasal and facial aspects are thin. Below, the roots of the first and second upper molar teeth and of the bicuspid are merely separated from it by a thin plate of bone, above, the infra orbital nerve and vessels are imbedded in the superior wall. It is lined by an extension of the mucous membrane of the nasal cavity, which constitutes a muco-periosteum and the communication occurs on the mesial wall being badly placed for drainage purposes nearly an inch from the floor, so that any escape of secretion—if abundant and not removed by ciliary action—takes the form of an overflow. This opening, moreover, is under cover of the middle turbinal, not far from the lower end of the fronto-nasal duct and of the exit of the anterior ethmoidal cells, so that when infection has attacked one cavity it is very likely to spread to others.

Chronic distension of the antrum may arise from new growth or dental cyst formation, and may be manifested in any of four directions:—(a) Inwards, causing obstruction to nasal respiration, and possibly epiphora, from compression of the nasal duct, (b) upwards, leading to protrusion of the eyeball or *exophthalmos*, (c) downwards resulting in depression of one side of the palate, and possibly irregularity in the line of the teeth, and (d) outwards, giving rise to a somewhat characteristic projection of the cheek beneath the malar eminence. Under these circumstances, a finger inserted into the mouth between the cheek and the bone, will detect fullness and possibly a loss of resistance in the anterior wall of the antrum, or the whole anterior wall may be absorbed and an elastic swelling take its place. Infra orbital neuralgia is often a marked feature in these cases.

Suppuration within the Antrum (*empyema of maxillary sinus*) frequently arises from disease connected with the roots of the first or second molar or first bicuspid teeth. It more commonly results from an acute inflammation of the nasal cavities due to infection by *B. influenzae*, pneumococcus, streptococcus, *Micrococcus catarrhalis* or staphylococcus and may be associated with trouble in the other accessory nasal sinuses such as the frontal and ethmoidal. It is occasionally lighted up by injury as in boxing, football or fighting, or the cavity may be infected by bathing in the sea, stagnant ponds or swimming baths. In chronic hyperplastic cases the antrum is filled with soft polypoid masses.

The Symptoms produced are often extremely equivocal and the condition may be present for some time without being recognized.

In the chronic forms all that is noticed may be an intermittent discharge of pus into and from one side of the nose associated perhaps with nasal obstruction, a chronic cough and an irritable throat. The pus varies considerably in amount and character, being sometimes extremely offensive. On holding the patient's head forwards there is often an overflow of pus into the nostril and sometimes when the patient reclines it flows back into the pharynx. *Cacosmia* (a bad smell perceived by the patient) is almost always diagnostic of dental root infection of the antrum with mouth organisms. Should the opening into the nose become blocked all the symptoms are aggravated, possibly with pain and swelling.

In acute cases all the above phenomena may be present accompanied by severe tensive pain and some amount of febrile disturbance. Tooth-ache in one or more teeth of the affected side is often due to neuritis of one or more branches of the superior dental nerve. Osteomyelitis of the bony walls may also be induced in children, since the mucous membrane is closely adherent to the periosteum. This complication however usually results from primary infection in a tooth socket.

The Diagnosis of suppuration within the antrum is not always easy. The discharge of pus from the nose is suggestive, as also the presence of a dead or painful molar or bicuspid tooth. If a flow of pus can be induced by change of position of the head, it is pathognomonic of suppuration within one of the accessory sinuses connected with the nose, probably of the antrum. If after the nose has been cleared and the head hung down, pus is seen welling up from under the middle turbinal, the diagnosis is almost certain. *Transillumination of the antrum* helps to confirm this opinion. A suitable electric lamp is placed within the mouth in a dark room, or the examination is made under a photographer's cloth, if the antra are normal the cheeks, lips and lower margins of the orbits become of a rosy red colour. On pulling down the lower lid the sclerotic is seen illuminated in its lower part and the pupil shows up as a red area, the light having passed through the antrum into the globe of the eye. If however the cavities are occupied by pus, blood, a growth or polyp, or if the mucous lining or bony walls are thickened, the parts remain dark. Transillumination does not answer in every individual and hence the value of the test is much diminished. The presence of illumination generally excludes intra-antral growths or abscess, but its absence unless unilateral is

not of much significance. Differences of illumination on the two sides are however of considerable diagnostic significance.

Radiographic Examination is of the greatest value the films being exposed through the occipito mental plane. A fluid level may be visible if there is retained secretion. In hyperplastic cases thickening of the lining membrane or polypus formation may be revealed.

Finally the antrum may be punctured with trocar and cannula through the inferior nasal meatus and an absolute diagnosis obtained by washing it out (Fig 620).

The **Treatment** necessarily varies with the type of the disease. It must always be remembered that the orifice of the antrum into the middle meatus is an inch above the antral floor, and hence the natural drainage is very defective being merely of an *overflow* type when the patient is erect if ciliary action is ineffective or has been paralyzed (Fig 620).

In all acute cases the cavity should be washed out from the nose the inner wall being punctured through the inferior meatus after efficient cocainization warm sterilized salt solution is employed. This lavage may be required at first daily but afterwards less frequently and in the intervals the patient is guarded from cold. Steam inhalations* of Friar's balsam menthol and eucalyptus oil every three or four hours are very helpful and comforting.

It is important to make certain that the point of the cannula is actually within the antral cavity before commencing lavage as it is possible that it is still in the nasal cavity or has crossed the antral cavity, and may be (a) in the orbital cavity or (b) under the cheek in the canine fossa or (c) in the pterygoid

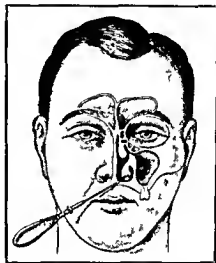


FIG 620.—THE FRONTAL ETHMOIDAL AND MAXILLARY SINUSES SHOWN DIAGRAMMATICALLY

The figure illustrates the good drainage of the frontal sinus as compared with that of the antrum of Highmore in which the ostium is placed high up thus favouring stagnation of secretions. A trocar and cannula are in position for lavage of the maxillary sinus the instrument pierces the naso-antral wall below the inferior turbinal body.

* For steam inhalations 1 pint of water at 180° F should be placed in a jug and the solution added. A towel is rolled up and placed around the mouth of the jug the nose and mouth are held over the jug the eyes remaining outside away from the steam. The patient breathes through the nose and closes one nostril at a time he should expire mainly through the mouth continuing the inhalation for five to ten minutes. He must remain in the same temperature for half an hour after the inhalation. A simple prescription is

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region. The syringe should always be filled with lotion before commencing the lavage as there is danger of air-embolism if this precaution be overlooked. The face must be watched when the syringe is first squeezed to detect any swelling due to mal placement of the needle.

In chronic cases intranasal operation will usually suffice to be effective the anterior part of the inner (nasal) wall of the antrum under cover of the inferior turbinal must be removed to allow of dependent drainage and lavage of the antrum. Sometimes there is a large accumulation of polypoid tissue within the antrum. To remove it the surgeon must make an opening for inspection by incising the mucous membrane and periosteum over the canine fossa after retracting the upper lip. He then makes an opening through the anterior bony wall (*Caldwell-Luc operation*). Effective removal of hyperplastic mucosa can then be performed under direct vision but this buccal opening is allowed to close at the end of the operation. The lining membrane should not be completely removed except in very rare cases. An opening into the nasal fossa is then made through the inferior meatus as in intranasal antrostomy.

Drainage of the antrum through a tooth socket was formerly in vogue but is now seldom used because of the disadvantage of constant re infection of the cavity from the mouth.

Hydrops Antri is the term applied to a chronic distension of the antrum with a glary mucoid fluid somewhat similar in character to that contained in a ranula. It is due to the formation of a dental cyst which has encroached on the antral cavity. rarely it is due to the presence of a dentigerous cyst. The *treatment* required is to open the cyst thoroughly through the canine fossa. An opening is made into the inferior meatus of the nose to drain both antrum and cyst.

Various Tumours may originate in the antrum e.g. odontomata, osteomata, sarcomata and carcinomata. If limited to the cavity they produce no definite symptoms except when large enough to cause expansion of its walls. Malignant growths however generally pass beyond the limits of the antrum and lead to the usual signs of malignant disease of the upper jaw. *Treatment* consists in removing simple growths if possible without interfering with the integrity of the maxilla. This may be accomplished by reflecting the overlying cheek as in the Caldwell Luc operation. For the larger or malignant tumours complete removal can usually be accomplished by means of Moutre's or Denker's operation. Anatomical removal of the upper jaw is never practised.

The **Ethmoidal Cells** lie along the inner wall of the orbit and should the orbital ethmoidal plate be perforated or necrosed one or more cells may burst into and infect the orbital cavity leading to orbital cellulitis which is most commonly of nasal origin. Ethmoidal disease generally leads to excessive polypoid formation and caries of bone takes place beneath the diseased mucous membrane from which the polypi are derived.

The **Sphenoidal Sinus** lies at the back of the nose and drainage thereof in diseased conditions is partly of the overflow type (Fig. 619 S) the discharge escapes downwards into the naso-pharynx and

often leads to great crust formation around the posterior nares. Suppuration therein may occasionally cause deep seated pain in the back of the orbit and nose and over the occiput, thrombosis of the cavernous sinus, retro bulbar neuritis, involvement of orbital nerves, or even basal meningitis are possible complications.

Treatment, except in the simpler cases should always be handed over to a rhinological expert as operative measures, often of a serious character, may have to be undertaken. The essential element is drainage of the affected cavities together with removal of the polypi and diseased bone which hinder the exit of the discharge. In acute cases it is always desirable for a few days to treat the patient merely by medicated steam inhalations, and lavage of the maxillary sinuses, if necessary, but further and more effective treatment is usually required in chronic cases. In many patients the lining membranes of these cavities will be thickened and transformed into polypoid masses. The more extensive procedures mentioned are likely to be required for the frequently associated disease of the antrum. For disease of the ethmoid cells it may suffice after removal of the middle turbinal to break through by means of Grunwald's forceps and to remove the entire inner ethmoid wall, as well as the partitions between the various cells and all polypi. For disease of the *sphenoidal* sinus the anterior wall must be removed by a special punch forceps down to the floor. In mild cases of sphenoidal infection catheterization and lavage with saline solution may effect a cure. In severe cases where all the sinuses are infected, it may be necessary to work through an external incision.

Frontal Sinuses

These sinuses are cavities in the frontal bones lined with a mucous membrane continuous with that of the nose. They are seldom large in children before the age of puberty. In adults they vary much in size and shape and are often very asymmetrical, the prominence of the superciliary ridges is no guide to their extent. Information as to these points may be gained by radiography, the rays being directed from behind and the plates placed in this way. The presence of pus and of tumours may be determined in this way. Trans illumination is seldom useful.

Fracture of the anterior wall is not uncommon as the result of a direct blow, depression of the fragments being produced, but without cerebral complications. If the mucous membrane is torn, surgical emphysema of the scalp and face may follow, and is naturally increased on blowing the nose. In open fractures, suppuration usually occurs leading to septic osteitis and necrosis of the frontal bone, and if the posterior wall is involved, to an extradural or even a cerebral abscess. When the anterior wall only has been destroyed, a localized collection of air may form under the skin and remain as a permanent tumour, known as a *pneumatocele capitis*, it rises and falls with forced respirations.

Inflammation of the frontal sinus is caused by extension from the

region. The syringe should always be filled with lotion before commencing the lavage as there is danger of air-embolism if this precaution be overlooked. The face must be watched when the syringe is first squeezed to detect any swelling due to mal placement of the needle.

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The Ethmoidal Cells lie along the inner wall of the orbit and should the orbital ethmoidal plate be perforated or necrosed one or more cells may burst into and infect the orbital cavity leading to orbital cellulitis which is most commonly of nasal origin. Ethmoidal disease generally leads to excessive polypoid formation and caries of bone takes place beneath the diseased mucous membrane from which the polypi are derived.

The Sphenoidal Sinus lies at the back of the nose and drainage thereof in diseased conditions is partly of the overflow type (Fig. 619 S) the discharge escapes downwards into the naso-pharynx and

often leads to great crust formation around the posterior nares. Suppuration therein may occasionally cause deep seated pain in the back of the orbit and nose and over the occiput. thrombosis of the cavernous sinus, retro-bulbar neuritis involvement of orbital nerves, or even basal meningitis are possible complications.

Treatment, except in the simpler cases should always be handed over to a rhinological expert as operative measures, often of a serious character, may have to be undertaken. The essential element is drainage of the affected cavities together with removal of the polyp and diseased bone which hinder the exit of the discharge. In acute cases it is always desirable for a few days to treat the patient merely by medicated steam inhalations, and lavage of the maxillary sinuses, if necessary, but further and more effective treatment is usually required in chronic cases. In many patients the lining membranes of these cavities will be thickened and transformed into polypoid masses. The more extensive procedures mentioned are likely to be required for the frequently associated disease of the antrum. For disease of the ethmoid cells it may suffice, after removal of the middle turbinal to break through by means of Grunwald's forceps and to remove the entire inner ethmoid wall, as well as the partitions between the various cells and all polypi. For disease of the *sphenoidal* sinus the anterior wall must be removed by a special punch forceps down to the floor. In mild cases of sphenoidal infection catheterization and lavage with saline solution may effect a cure. In severe cases where all the sinuses are infected, it may be necessary to work through an external incision.

Frontal Sinuses

These sinuses are cavities in the frontal bones lined with a mucous membrane continuous with that of the nose. They are seldom large in children before the age of puberty. In adults they vary much in size and shape and are often very asymmetrical, the prominence of the superciliary ridges is no guide to their extent. Information as to these points may be gained by radiography the rays being directed from behind and the plates placed in front. The presence of pus and of tumours may be determined in this way. Trans illumination is seldom useful.

Fracture of the anterior wall is not uncommon as the result of a direct blow, depression of the fragments being produced, but without cerebral complications. If the mucous membrane is torn, surgical emphysema of the scalp and face may follow, and is naturally increased on blowing the nose. In open fractures, suppuration usually occurs, leading to septic osteitis and necrosis of the frontal bone, and if the posterior wall is involved, to an extradural or even a cerebral abscess. When the anterior wall only has been destroyed a localized collection of air may form under the skin, and remain as a permanent tumour, known as a *pneumatocoele capitis*, it rises and falls with forced respirations.

Inflammation of the frontal sinus is caused by extension from the

nose generally it follows empyema of the maxillary sinus and seldom arises as a primary condition except in rare cases of penetrating wounds or fracture. It produces headache localized to the region of the sinus with tenderness or pain on pressure. Fever and a feeling of mental dulness are present. As mentioned above no operation should be performed on the frontal sinus during the acute stage except under necessity when an abscess has broken through its walls or when spreading osteomyelitis is present. Lavage of the maxillary sinus is required in the majority of cases. This treatment is combined with steam inhalations and the encouragement of drainage from the fronto-nasal duct by the application to the region of the middle turbinal body of small pledgets of wool soaked in 10 per cent protargol or $\frac{1}{2}$ per cent cocaine solution. Blockage of the fronto-nasal duct without infection of the cavity can lead to mucocele. The floor of the sinus at the inner angle of the orbit is expanded. External operation may be required.

In the treatment of chronic infection of the frontal sinus external operation is avoided if possible. Any infection of the maxillary sinus is cured. Pathological enlargement of the middle turbinal is rectified by operation. Any polyp obstructing the fronto-nasal duct are removed. Infected anterior ethmoidal cells are drained and any marked deviation of the nasal septum is corrected. If the condition is not cured or markedly ameliorated thereby external operation is performed. An incision is made just below the eyebrow internal to the supra-orbital nerve and curving round the inner margin of the orbit. Part of the floor of the frontal sinus is removed but the anterior wall is left intact except in rare cases of osteomyelitis.

A free communication is made between the sinus and the nose by removal of parts of the nasal lachrymal ethmoidal and superior maxillary bones. It is of great advantage and in our opinion essential to apply a skin graft to the newly formed opening.

Intra-cranial Complications of sinusitis may cause extradural abscess, localized or diffuse meningitis or frontal lobe abscess. These rare complications are seldom spontaneous but more often appear after operations. The infection arises from the frontal ethmoidal or sphenoidal sinuses and passes in by direct continuity after fracture or caries of bone or enters through venous channels. Opening of the anterior fossa of the skull is carried out through the posterior wall of the frontal sinus if indicated. Meningitis of nasal sinus origin is almost invariably fatal.

Acute Osteomyelitis is a dangerous complication of acute frontal sinusitis. It is occasionally primary but is more often the result of surgical interference in acute cases.

In the spontaneous type the patient has a good chance of recovery but the prognosis is very bad in post-operative cases.

Malignant Disease of the Nose may originate in various parts of the nasal fossæ or sinuses. Squamous-celled carcinoma occurs most frequently. The symptoms consist of blood-stained discharge and respiratory obstruction associated later with pain and cachexia. The disease commences either in the ethmoidal cells or in the mucous glands of the

antrum of Highmore In the former case the symptoms are referred mainly to the nose, but swelling usually appears during the progress of the condition at the inner angle of the orbit, the eyeball sometimes being displaced outwards, possibly with ophthalmoplegia or defective vision due to pressure on the optic nerve If the growth starts in the antrum, the first external sign is swelling of the cheek caused by forward displacement of the antral wall extension leads to involvement of the hard palate or alveolar margin, or to bulging inwards of the lateral nasal wall Actual breaking through into the nasal fossa causes a blood stained discharge and sinuses may appear in the skin of the cheek The course of the disease is usually rapid, owing to the great vascularity of the part, but lymphatic glands are not involved until very late It is possible to deal with these patients by operative measures which must be varied according to the requirements of the case Radium may be of service after removal of the growth by excision and diathermy

Sarcoma also may commence in the nose itself It gives rise to the usual signs of an intranasal growth and may sometimes be dealt with in a satisfactory manner by surgical removal and the application of diathermy, followed by radium Not a few cases are on record in which such treatment has proved efficacious in curing the disease

The operations which have been devised for dealing with malignant disease of the nose and naso pharynx are so numerous and complicated that it is impossible for us to mention more than a few of the most useful and important

(a) In some cases of intranasal disease *Rouge's operation* has been recommended, but is now seldom used It consists in the detachment of the mask of the face from the maxilla by everting the upper lip and incising the mucous membrane and subjacent tissues until the nasal cavities are opened The septum nasi is divided by cutting pliers, and the nasal cartilages are completely separated The soft tissues of the face can then be retracted upwards and the nasal fossæ fully exposed The bleeding is always considerable and the space gained in children is but slight When the operation is completed, the mask of the face is allowed to fall back again into position union occurring without difficulty

(b) When the upper and anterior portion of the nasal cavity is to be dealt with, *lateral rhinotomy*, as described above (p 937) or some modification of it, may be employed with advantage Any area of skin infiltrated by growth must, of course, be removed The same operation gives excellent access to the naso pharynx

(c) When the disease is located further back, originating rather in the naso pharynx than in the nose itself, the *palatine route* may be used Perhaps the best of the several suggested operations is that of *Nelaton* This consists in a median section of the velum and of the mucous membrane covering the posterior half of the hard palate, most of which is cut away as also the back of the vomer, if necessary The naso-pharynx is thus opened sufficiently to allow of the removal of the growth The reflected segments of the palate are subsequently sutured together This operation is now seldom undertaken owing to

the possibility of non union of the palatal flaps and the greater advantages of the lateral nasal route

(d) By elevating the upper lip and opening the antrum through the canine fossa and then removing the lateral wall of the nose as in Denker's operation extensive growths can be removed provided they do not involve the higher regions overmuch and particularly the frontal sinus. Part of the upper alveolus is taken away and after clearance of the growth by surgical excision and diathermy a large opening is left through which the cavity may be inspected for possible recurrence. The deficiency is rectified by the provision of an obturator carried on a denture with no disfigurement. In our opinion this operation is to be preferred for almost all malignant growths of the nose and sinuses.

Naso-pharynx.

Adenoids.—It has been already mentioned that the naso-pharynx is the seat of a large amount of lymphoid tissue similar to that met with in the tonsil, which may either be distributed widely over the whole mucous membrane or be gathered into a special mass on the roof known as the pharyngeal or Luschka's tonsil. Adenoids consist in a hypertrophy of this tissue exactly analogous to the chronic hypertrophic form of tonsillitis with which indeed it is often associated. They usually occur in the form of broad cushion like masses springing from the roof or posterior walls. The formations are extremely soft and vascular bleeding very readily. The surface is plicated and in the recesses or folds between the different portions of the mass bacteria lodge and give rise to various inflammatory troubles locally and occasionally in neighbouring lymphatic glands. Not uncommonly isolated masses similar in structure to the above are also to be seen on the posterior wall of the pharynx, and a certain amount of chronic rhinitis and laryngitis may be associated. The condition is rarely seen in others than children and especially those living in the smoky atmosphere of large towns. If untreated adenoids usually disappear by the age of twenty but not before much harm may have been done to the individual.

The Symptoms are mainly due to obstruction to nasal respiration. The mouth is generally held half open so as to allow the child to breathe through it thereby exposing the upper central incisors (Fig 621) from a similar cause he snores during sleep and usually wakes with the mouth and tongue dry. The nostrils are drawn in and the nose is thin and pinched the whole facies being very characteristic the children often look sleepy and half silly and indeed may be very backward in their studies. Not uncommonly there is a certain amount of semi purulent discharge from the nose or it may be hawked up from the pharynx perhaps mixed with blood. Deafness is caused if the tympanic membranes are indrawn because of obstruction of the Eustachian tube. Acute or chronic otitis media often results from extension of the catarrhal condition of the mucous lining of the Eustachian tubes and deafness may be induced thereby both taste

and smell are sometimes impaired as a result of hypertrophic rhinitis. The ethmoid and maxillary sinuses may become infected. The palate becomes high and arched, owing to the altered intranasal air pressure and as the patient grows up the incisor teeth may project forwards giving a curious rabbit like expression to the face. The cervical glands become infected from the tonsils and are enlarged and are often the seat of tuberculous disease. In bad cases which have been allowed to persist throughout adolescence the thorax becomes flattened the ribs are drawn in and the spine is kyphotic (Fig 622)



FIG 621—ADENOID FACIES (FROM A PHOTOGRAPH KINDLY LENT BY SIR ST CLAIR THOMSON)

This illustration shows well the sleepy look the pinched nostrils the open mouth and projecting upper central incisors so characteristic of this condition



FIG 622—LATERAL VIEW OF A CHILD WITH NEGLECTED ADENOIDS (FROM A PHOTOGRAPH LENT BY SIR ST CLAIR THOMSON)

This is the same child whose face appears in Fig 621. It will be seen that the chest is shallow and retracted and the spine kyphotic. The arms are small but the legs are well developed

Physical Examination consists in posterior rhinoscopy, by means of which the adenoids can be seen or in palpation of the posterior nares, a process occasionally necessary in children, who rarely have sufficient control to permit of the former. On passing the finger behind the velum the naso pharynx is found to be occupied by a soft mass of tissue which readily bleeds, and more or less obstructs the openings of the posterior nares

Circumstantial evidence is derived from the symptoms, from the presence of enlarged and unhealthy tonsils and from the retraction of the tympanic membranes, a diagnosis of adenoids is thereby made

without the necessity or desirability of the unpleasant post nasal palpation.

Treatment consists in removal of the adenoids by operation. In young adults arsenic in small doses (liquor arsenicalis ℞i. b or t d s) may be of value after operation. Nasal douches must never be used for fear of setting up infection in the sinuses or ears. The only effective way of dealing with the condition is by surgical removal whatever the age of the child.

Operation—The child lying on its back flat or with a pillow under the shoulders is anesthetized with ethyl chloride either alone or preferably followed by ether. If enlarged tonsils co-exist these should be dealt with in the first place. Gottstein's curette or some modification of it is then introduced behind the soft palate. It is pressed upwards so that its free convex edge impinges on the upper part of the posterior border of the nasal septum. It is then swept backwards and downwards over the pharyngeal wall so as to shave away the chief portion of the projecting mass of adenoids. Possibly the application of a second curette may be required to deal with outlying lateral portions care being taken to clear away any masses lying in the fossa behind each Eustachian cushion as these are

a common cause of chronic middle-ear infections. Any remaining tags are removed by the use of Lucas or any other suitable forceps. La Force's adenotome (Fig 623) is a most useful instrument



FIG 623 LA FORCE'S ADENOTOME

and is preferred by many to a curette. By its use the whole mass of adenoids can be removed cleanly with no possibility of damaging the pharyngeal aponeurosis or constrictor muscle. There is considerable bleeding but this quickly stops of itself except in rare cases which require plugging of the naso-pharynx. The blood is removed by a suction pump but if one is not available the child should be turned over and held face downwards immediately after the operation so as to allow the blood to run out of the mouth and nose whilst the face and forehead are sponged with ice-cold water to check the hemorrhage. Many surgeons prefer to perform the operation with the child lying on his side. The patient is kept indoors for a few days and only fluid food allowed. The most likely complication is acute otitis media indicated by earache and rise of temperature. No local after treatment is required as a rule but the throat may be gargled with a mild antiseptic. Nose-breathing exercises should subsequently be instituted and in many bad cases are as important as the operation.

Naso-Pharyngeal Fibroma is the term applied to a neoplasm which may become sarcomatous. It springs from the base of the skull either from the basi-sphenoid or basi-occipital. It is usually firm smooth and fleshy in character. When of large size it may be lobulated. The early symptoms are almost limited to those of obstruction to nasal respiration but to this is not unfrequently added severe epistaxis.

owing to the vascularity of the capsule and of the overlying mucous membrane. As it increases in size, ulceration occurs, leading to a fetid sanious discharge, and the growth rarely remains limited to the naso pharynx. If pushing forwards, it may lead to expansion of the bridge of the nose and separation of the eyes, which may even be made to diverge, but if backwards, it may depress the velum, and hang downwards. In other cases it may burrow into the orbit of any of the other surrounding cavities, or may even erode the base of the skull, or encroach upon the cranium. It is rare for any of these latter manifestations to occur until after the tumour has become sarcomatous.

The disease usually attacks young people, and mainly those in the second decade of life. It progresses with considerable rapidity if malignant changes take place, and the fatal issue may be due to hæmorrhage, asphyxia, or cerebral complications.

In rather older subjects a sarcoma may appear in the naso pharynx as a primary growth, with symptoms similar to those already described. The course is rapid.

Primary carcinoma also occurs, and may spread down the naso pharyngeal wall to appear below the soft palate. The Eustachian tubes are obstructed by the growth, with symptoms of deafness at an early stage.

Treatment.—The aim in simple cases, whether the tumour is small or large, is to remove it completely, together with the underlying periosteum from which it arises. Nélaton's operation will in some cases assist the surgeon to reach the base of the skull and deal with the tumour. Lateral rhinotomy is sometimes more satisfactory. In the more severe cases, where the growth has become diffuse, it is very doubtful whether any good can be done by operation, since the base of the skull is certain to be gravely affected. Radium may then be of real use, leading to marked shrinkage and fibrosis of the tumour, as also to the destruction of any small portions remaining after operation.

Malignant growths respond well to deep X ray therapy, and therefore this is recommended as the method of choice, whether the growth be carcinomatous or sarcomatous. The treatment must be drastic and involves considerable discomfort to the patient.

CHAPTER XXXIII

AFFECTIONS OF THE TONSILS AND PHARYNX.

By V. E. NEGUS M.S. F.R.C.S.

Acute Tonsillitis results from bacterial infection sometimes of a semi epidemic type. The palate fauces and pharyngeal walls generally participate in the inflammatory process among the organisms present are staphylococci pneumococci and streptococci occasionally one type in almost pure culture but more commonly as a mixed infection. Two varieties of acute tonsillitis are described but there is no sharp line of demarcation.

(a) **Acute parenchymatous tonsillitis** causes general enlargement of the organ which is dusky red in colour and painful causing obstruction to swallowing and sometimes to breathing also in those cases in which the tonsils almost meet in the middle line. The temperature is high the glands below the angle of the jaw become enlarged and tender, the tongue is covered with a thick whitish fur and the bowels are confined. The local condition may be associated with septicæmia in severe cases.

(b) **Acute follicular tonsillitis** differs only from the description just given by marked involvement of the tonsillar crypts from which a yellow exudate discharges itself coagulating on the surface to form a false membrane unlike that of diphtheria however in that it does not cause bleeding when detached.

This type of inflammation affects more often tonsils of the buried variety while the parenchymatous enlargement is associated with prominent tonsils.

Peritonsillar abscess or *quinsy* is a complication of acute inflammation of the tonsil with suppuration around it. The usual site of the abscess is just outside the capsule at the upper pole infection extends outwards through the superior tonsillar fossa. Occasionally an abscess forms in the tonsil itself. Both sides are inflamed but the suppuration is often unilateral or if bilateral one tonsil is affected before the other pus usually takes three to seven days to form. The swelling is great so that breathing and swallowing are alike difficult the temperature is high pain is severe and the cervical glands are considerably enlarged. Edema of the glottis may result. Other symptoms are much the same as in the above. Left to itself the abscess sooner or later points and bursts usually in the soft palate above and to the outer side of the tonsils and this gives the patient immediate relief.

The Diagnosis must be made from *scarlet fever* by the absence of the characteristic rash and red tongue of the latter condition and by the redness being more dusky and less diffuse in tonsillitis. From

erysipelas of the fauces, it is known by the redness being more concentrated, the œdema less marked and more limited, by the glands at the angle of the jaw being less enlarged, and by the absence of any external manifestation of the disease. From *diphtheria* the follicular variety is recognized by the want of adhesion of the false membrane to the subjacent parts and by the absence of the Klebs Löffler bacillus on cultivation. In acute tonsillitis the temperature tends to reach a higher level.

Treatment should always be commenced by a good calomel purge, which may be followed by the administration either of salicylate of soda (10 grains, thrice daily), or of chlorate of potash. The patient will experience much relief by inhaling the steam from hot water (180° F), in which a little Friar's balsam (3i) and menthol (gr iii) is dissolved, or the tonsils may be painted with a 10 per cent solution of protargol or 5 per cent solution of guaiacol in glycerine several times a day the latter paint acting both as an antiseptic and as a local anæsthetic. Pus is evacuated as early as possible, and it is desirable that this should be effected by the use of sinus forceps after incision of the superficial layers with a guarded scalpel. The surface may be anæsthetized with equal parts of cocaine solution (10 per cent) and adrenalin, applied on a wool swab.

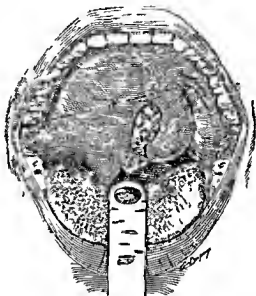


FIG 624 — DIAGRAM TO INDICATE THE SITUATION TO OPEN A PERITONSILLAR ABSCESS VIZ ON A LINE DRAWN FROM THE BASE OF THE UVULA TO THE LAST MOLAR TOOTH BUT NEARER THE UVULA (AFTER SIR ST CLAIR THOMSON)

Fig 624 indicates the point of election at which to open a peritonsillar abscess viz a little internal to a point midway between the base of the uvula and the last upper molar tooth (Sir St Clair Thomson). The opening is suitably enlarged downwards and towards the middle line. It is essential not to go too deep or too far outwards so as not to injure the superior constrictor or to open through the deep fascia. Both before and after opening the abscess, hot flannels or fomentations may be applied to the neck and throat, and plenty of fluid nourishment administered when the patient can swallow comfortably. This is followed as soon as possible by tonics. The fact that quinsy is very liable to recur suggests that during the quiescent interval after an attack the tonsils should be removed by enucleation.

of operation or later (reactionary or secondary) It can usually be controlled by direct pressure applied to the raw surface by means of a pad or plug of gauze and held by suitable forceps counter pressure of a finger from the neck may be of assistance Morphia to keep the patient quiet and ice to the neck may be used in post-operative cases before suturing Hamoplastin given by injection or applied locally to the tonsil fossa may stop the hæmorrhage If bleeding is excessive search must be made for bleeding vessels general anaesthesia being used if necessary Ligatures are applied where required suture of the pillars of the fauces over a small roll of gauze soaked in iodoform is undesirable but is occasionally called for In adults an alkaline mixture may be given before the operation for three or four days sufficient to render the urine alkaline

Syphilitic Disease of the tonsil is met with in various stages The primary chancre is seen occasionally The glandular enlargement in the neck is very marked in such cases and the course of the disease as a rule severe Secondary ulcers of the 'snail track' type (*plaques migneuses*) are common in this region being usually symmetrical In the tertiary period a diffuse gummatous infiltration occurs involving also the palate and fauces and leading to pharyngeal stenosis

Tumours of the Tonsil are almost always malignant in type but are not very common *Epithelioma* occurs as a firm indurated infiltration rapidly spreading to adjacent parts with early involvement of the lymphatic glands It starts either in the tonsil itself near the root of the tongue or in the pillars of the fauces and presents a ragged ulcerated surface with a hard margin and sloughing base It is not always painful and notice may first be called to it by the enlargement of the glands in the neck It runs a rapidly fatal course if left to itself *Lympho-sarcoma* of the tonsil arises in the organ itself it presents a smooth dusky red appearance the mucous membrane being stretched over it and feels soft and almost fluctuating In the early stages it may be freely movable but before long it infiltrates surrounding structures and affects the neighbouring lymphatic glands *Round celled sarcoma* also attacks the tonsil as a primary growth and is less limited and defined than the former In all these varieties the growth extends into the pharynx impeding deglutition and respiration and ulceration with or without serious hæmorrhage may ensue indeed the latter complication is a frequent cause of the fatal result

Extirpation of Malignant Tumours of the tonsil is often impracticable from the extent of the disease and the early implication of the surrounding structures although it has now been shown that they are more amenable to treatment than was formerly thought to be the case The disease may be dealt with in two ways (a) *From the mouth* in the case of the loosely encapsuled and freely movable lympho-sarcomata The capsule is divided preferably by a diathermic cautery and the growth shelled out sometimes with the utmost ease and with very little hæmorrhage Removal should be followed by radio-therapy but recurrence in the lymphatic glands is almost certain to follow (b) *From the mouth* in cases of epithelioma diathermy being used to coagulate the growth which is then removed piecemeal Preliminary ligation of

the external carotid artery is advisable, combined at the same time with block dissection of glands in the neck, if there is any suspicion of their infection. (c) *From the neck* This plan may be of value in dealing with an epithelioma. A vertical incision is made along the anterior border of the sterno-mastoid with a second horizontal arm, and a careful dissection conducted down to the pharyngeal wall, removing all lymphatic glands, and securing the external carotid or its anterior branches. The mass is then isolated from the surrounding structures and removed, after dividing the mandible to give free approach, part of the lower jaw bone is removed, together with the growth.

New growths of the tonsil respond well to radium. The best method is to commence with teluradium, and to follow this by needles inserted through the mouth arranged so as to irradiate the whole of the growth, or applied to the surface in the form of a plaque. Small residual areas may be destroyed by diathermy.

Affections of the Pharynx.

Acute Pharyngitis is usually associated with a similar inflammatory condition of the velum palati, nasal mucous membrane, and tonsils, and results from exposure to cold, from inhalation of septic organisms, and from general diseases of the exanthematous type, *e.g.* scarlet fever and diphtheria. It is characterized by redness, pain and swelling of the mucous membrane, which becomes covered with mucus or muco-pus. An irritable cough, perhaps with sneezing, interference with nasal respiration, and great pain on swallowing, is produced by this condition, and if it spreads to the Eustachian tube temporary deafness is induced. Ulceration of the velum and fauces occasionally follows.

The Treatment consists in attending to the general condition, especially if of exanthematous origin, and in administering antiphlogistic remedies, *e.g.* purgatives, sudorifics, and diuretics, and soothing local applications, *e.g.* lozenges of phenol (gr $\frac{1}{4}$), ice to suck, chlorate of potash or phenol gargle etc. Great relief is often given by inhaling steam from water at 180° F, to which a drachm of Friar's balsam and 3 grams of menthol has been added. A spray of protargol (2 per cent) or a paint (10 per cent) are useful.

Chronic Pharyngitis is commonly met with in clergymen and public speakers who are called upon to exert their voices for any length of time, in costers and street hawkers who shout their wares, and in drinkers and smokers. In the majority of cases it is secondary to some form of rhinitis or sinusitis, or to nasal obstruction. It may commence as a chronic inflammation, or may follow an acute attack. The mucous membrane is more or less red and infiltrated, with vessels coursing over it, and there is often a good deal of muco purulent discharge. If the buccal side of the velum palati is affected, there is usually much less secretion than from the pharyngeal aspect, where a considerable amount of dark green viscid material may collect and cling to the pharyngeal wall, constituting scabs, which may decompose

and cause the breath to be somewhat offensive. In addition to the simple type two special varieties are described.

1. *Chronic follicular or granular pharyngitis* in which the lymphoid follicles scattered throughout the mucous membrane become enlarged. This is especially evident behind the soft palate and upon the posterior wall and sides of the pharynx. At times the mucous membrane is thrown by lymphoid enlargement into two longitudinal folds, one on either side of the middle line just behind the posterior faucial pillars. The uvula may be elongated and hypertrophic.

2. *Chronic atrophic pharyngitis* is associated with the atrophic form of rhinitis (p. 991) and may lead to chronic laryngitis and tracheitis. The mucous membrane is smooth, dry, and glazed and the exudation forms adherent scabs. The throat feels dry and irritable and the voice is often husky.

The Treatment of chronic pharyngitis varies with the condition and character of the affection. In many cases the nasal trouble is the more urgent and if it is treated effectively the pharynx improves rapidly. In simple relaxed throats all sources of irritation—such as smoking, spirits and condiments—must be avoided, the bowels and digestion attended to and astringent sprays, gargles or applications made use of. The most useful reagents are paints containing iodine (Mandl) or guaiacol, the glycerine of tannic acid and equal parts of glycerine and tinct. ferri perchloridi whilst menthol and benzoin inhalations are sometimes valuable, as also sprays of menthol dissolved in paroline or lozenges containing menthol and liquorice or carbolic acid. When the inflammation is of the follicular type it may be necessary to destroy the follicles with the galvano-cautery after cocaineizing the surface; enlarged and varicose vessels may be divided in the same way.

Vincent's Angina is an ulcerative form of pharyngitis due to the presence of the *B. fusiformis* and to a certain type of spirochæte. It is characterized by the development of an ulcer on one tonsil, sometimes spreading to the pillars of the fauces and occasionally elsewhere in the mouth or pharynx; these ulcers may be clean or may be covered by an abundant yellowish white fibrinous pseudo-membrane which is very adherent so that its removal involves bleeding. Constitutional symptoms are very slight but swallowing is somewhat painful.

Treatment.—An injection of an arsenic preparation such as novarsenobillon rapidly cures the disease. A solution of the same substance may be used for direct application to the tonsil with advantage.

Syphilitic Affections of the Pharynx may be met with in the secondary or tertiary stages. In the former they are of a superficial character such as mucous tubercles, snail track ulcers, etc. in the latter they appear in the shape of a *diffuse gummatous infiltration* which is often of considerable consequence both at the time and subsequently. It manifests itself as a widespread nodular thickening of the mucous membrane especially in the neighbourhood of the fauces and soft palate which rapidly runs on to ulceration and may impede both respiration and deglutition. The administration of salvarsan or of mercury and iodide of potassium should cause rapid improvement but the subsequent cicatrization may bind down the velum and lead to

pharyngeal stenosis of such a character as to constitute a fibro cicatricial septum, with an opening through it perhaps only large enough to allow a small bougie to pass. For such a condition much may be done the opening may be dilated by careful division of some of the bands and the passage of bougies. Of course there is a great tendency for the opening to contract again, and treatment by bougies or a soft rubber tube must be maintained, while in resistant cases skin grafts must be applied to raw or divided surfaces.

A *localized gumma* may form in the submucous tissue not infrequently involving the posterior pharyngeal wall, and running its ordinary course with or without ulceration.

Epithelioma either involves the pharynx primarily, or spreads to it from adjacent parts, such as the tongue or tonsil. The most common positions for a growth are in connection with the tonsil in the pyriform fossa, at the base of the tongue, and in relation with the epiglottis or aryepiglottic fold. The usual type of tumour develops with some amount of ulceration, lymphatic glands later become secondarily affected and the tumour gradually invades surrounding tissues, although it is interesting to note that for some time it is limited to the mucous membrane, extending superficially over it, but not involving the underlying pharyngeal muscles. Death results from general exhaustion from hæmorrhage due to ulceration into large vessels, from interference with swallowing or breathing from long infections, from pressure on important nerves, or from general dissemination.

Treatment.—Growths in the tonsil have been considered above. For those on the lateral pharyngeal wall, in the pyriform fossa, or on the aryepiglottic fold, operation is undertaken by Trotter's method of lateral pharyngotomy. An incision is made along the anterior border of the sterno mastoid, glands are removed by partial or complete block dissection together with the internal jugular vein. The sterno mastoid muscle is then sewn over the carotid sheath to the prevertebral muscles, and the lateral wall of the pharynx is freed. Part of the hyoid bone may require removal but if the growth is low in the pharynx approach is obtained by removal of the greater part of the thyroid ala. The growth is dissected away with a sufficient margin of surrounding healthy tissue, the pharynx is closed, if possible at the time, but occasionally a subsequent plastic operation is necessary. If the growth is near the larynx, tracheotomy is desirable. *Radium* has been used in many cases with success the needles being carefully arranged outside the growth after sufficient exposure by external operation. The best approach to neoplasms in the mid line, either at the base of the tongue or on the centre of the epiglottis, is by Trotter's median pharyngotomy.

Retro-pharyngeal Abscess is acute or chronic in its course. The *acute* form results occasionally from infection through the mucous membrane, as by fish bones etc. usually it arises from an inflammation of the lymphatic glands, which are found in this situation in children but atrophy in adults, and derive their lymph from the interior of the nose and naso pharynx. The pus is situated between the pharyngeal wall and the prevertebral fascia, and is therefore near the surface and

limited to one side. The *chronic* variety generally follows tuberculous caries of the spine or disease of the bones at the base of the skull and the pus is placed behind the prevertebral fascia spreading across the mid line. Whether acute or chronic the abscess forms a tense elastic swelling situated behind the posterior pharyngeal wall in the former case it is associated with high fever and locally much redness and inflammatory oedema which may even extend to the glottis and cause dyspnoea in the latter where the affection is chronic there is less local inflammatory reaction but signs of cervical caries may be present. The abscess may burst into the pharynx or may burrow outwards on either side being guided by the prevertebral fascia and point either in front of or behind the sterno-mastoid.

Treatment should never be delayed from fear of the supervention of oedema of the glottis. The *chronic* abscess should always be opened

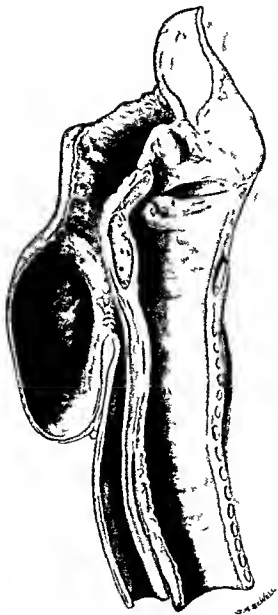
from the neck as then an aseptic course can be maintained aspiration is dangerous on account of the important structures lying in front of the abscess. If pointing in front of the sterno-mastoid the abscess is opened in that situation but otherwise an incision should be made along the posterior border of the muscle which must be drawn forwards and the transverse processes of the cervical vertebrae defined. Possibly the abscess will be opened by the necessary manipulation of the wound if not a pair of sinus forceps is thrust into it in front of the vertebrae. The cavity is opened sufficiently to permit of careful curetting it is then wiped and the wound closed completely without drainage.



FIG. 625.—LARGE DIVERTICULUM OF ESOPHAGUS (ROYAL COLLEGE OF SURGEONS MUSEUM)

The great majority of cases of *acute* abscesses however may be opened from the mouth without much fear. The child is placed on its back with its head hanging far back a gag is introduced and a guarded knife inserted through the mucous membrane into the swelling at its most prominent point. Careful swabbing or suction should avoid any danger of aspiration of pus liable to cause pulmonary trouble.

Pharyngeal Diverticulum—They occur in middle-aged or elderly individuals. They spring from the posterior wall of the pharynx just above its junction with the oesophagus and hang downwards along side the gullet in the lower part of the neck. They may be so large as to reach well into the mediastinum. The symptoms are due to distension of the cavity with food which stagnates forming a swelling in the neck which can be emptied by pressure. Loss of weight from want of food may result because of pressure of the sac on the oesophagus.



Diverticulum of the Pharynx
(Museum Royal College of Surgeons)

down which food is thus prevented from passing. The administration of a small barium meal and subsequent radiography will probably make clear the diagnosis which should be confirmed by œsophagoscopy. *Treatment* in mild cases consists in washing out the sac and dilating the crico-pharyngeal sphincter under direct vision. In severe cases it necessitates exposing the diverticulum in the neck through a lateral incision in front of the sterno-mastoid, removing it, and stitching up the opening in the pharyngeal wall. The operation may be carried out either in one or two stages.

CHAPTER XXXIV

AFFECTIONS OF THE ŒSOPHAGUS

Anatomical Considerations—The Œsophagus reaches from the lower extremity of the pharynx to the cardiac orifice of the stomach a distance of about 25 cm or 10 inches its upper limit corresponds to the lower border of the cricoid cartilage and its lower approximately to the lower end of the sternum. The distance from the central incisor teeth to the diaphragm is about 16 inches or 40 cm. The tube is not quite in the middle line but inclines to the left as it passes through the posterior mediastinum. The pericardium is in relationship with the Œsophagus in front and the pleura on each side. Its narrowest portions are its upper end which is kept closed by the crico-pharyngeus muscle in the centre about 2½ to 2⅞ cm from the teeth where the left bronchus crosses it and at the diaphragmatic hiatus. The pneumogastric nerves are also in immediate relationship with it.

The Methods of Examination of the Œsophagus are threefold

1 Examination with a laryngeal mirror may reveal the top of a neoplasm or may show the presence of froth in the pyriform fossa due to Œsophageal obstruction lower down or paralysis of a vocal cord caused by involvement of the recurrent laryngeal nerve in a carcinomatous growth.

2 *Radiography* is of assistance in the examination of the Œsophagus. Metallic foreign bodies can be seen and accurately located and by the use of swallowed barium it is possible to determine the situation of a stricture and the amount of dilatation of the Œsophagus above it (Plate XIV.)

3 The use of the *Œsophagoscope* has transformed the surgery of this organ. If local anæsthesia with cocaine is used it is advisable to administer a preliminary injection of morphia and atropin not only to dull the patient's sensitiveness but also to check the salivary secretion. General anæsthesia may be employed and is to be preferred in most cases. With the patient lying on his back it is possible to introduce the instrument and gently to insinuate it down the gullet. By this means foreign bodies growths strictures etc. can be seen and direct treatment controlled by vision can then be adopted. The blind use of bougies must never be employed.

Malformations of the Œsophagus are congenital or acquired.

A. *Congenital communication* may exist between the Œsophagus and trachea either in the form of a small fistula or the upper end of the Œsophagus may end blindly whilst the lower end opens into the trachea near its bifurcation. Life is impossible under such conditions and the children die shortly after birth.

Another type of abnormality takes the form of congenital shortening of the œsophagus. The gullet terminates at about the level of the seventh thoracic vertebra; below this level the food channel consists of stomach extending up through the diaphragmatic orifice. At the junction of œsophagus and thoracic stomach a stricture may be present leading to difficulty in swallowing.

The Acquired malformations consist in the development of *Diverticula*

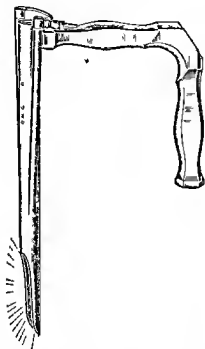


FIG. 626 —ŒSOPHAGEAL SPECULUM FOR EXAMINATION OF THE HYPOPHARYNX AND UPPER END OF ŒSOPHAGUS

The instrument is of Chevalier Jackson's type in shape but is fitted with twin obliquely set lens-fronted lamps designed to throw a light well forward.



FIG. 627 —ŒSOPHAGOSCOPE SIZE SUITABLE FOR CHILDREN FITTED WITH TWIN OBLIQUE LIGHTING AND DETACHABLE SUCTION TUBE FOR REMOVING SECRETIONS AND FOOD DÉBRIS

Two forms have been described (a) *Pressure Diverticula* may, rarely, be found at the lower end of the œsophagus. Those causing symptoms referred to the upper end are diseases of the pharynx, and are described on p. 1014 (see Fig. 625 and Plate XIII).

(b) *Traction Diverticula* are much rarer they occur on the anterior wall near the bifurcation of the trachea and are due to cicatricial traction from without by adhesion to an inflamed bronchial gland. They are always of small size and cause no symptoms. They cannot be recognized *ante mortem* except perhaps by direct œsophagoscopy.

Foreign Bodies frequently lodge in the œsophagus especially in children. The usual site of impaction is at the crico-pharyngeal fold or at the level of the thoracic inlet. Portions of food coins bones pins dentures etc. are the substances usually met with. The patient complains of pain in the gullet whilst swallowing is painful or impossible. Large bodies may be impacted against the aperture of the larynx and may then cause sudden death from dyspnoea if the obstruction is not so great and remains unrelieved œdema of the glottis may supervene. Impaction of sharp objects may be followed by ulceration perforation and death either from hæmorrhage owing to one of the large vessels being opened or from suppurative mediastinitis. In the case of a metallic body diagnosis both as to its presence and situation can be made by radiography.

The Treatment necessitates the use of the œsophagoscope. The foreign body should never be dealt with blindly by curved œsophageal forceps or a coin-catcher as in earlier days. The cases are therefore handed over to the laryngologist in hospitals. In the absence of such assistance the medical attendant is not justified in dealing with the case by blind methods. The patient can be transferred to a surgeon provided with the necessary equipment. Unskilled attempts at removal particularly if performed blindly will only add danger and must not be undertaken.

If perforation has taken place with infection of the tissues outside the œsophagus—leading to mediastinitis or the formation of an abscess—an incision 4 inches long is made along the anterior border of the sterno-mastoid preferably on the left side because the œsophagus naturally curves in that direction. The surgeon carefully finds his way between the carotid sheath on the outer side and the larynx and trachea on the inner avoiding the thyroid vessels and nerves. The external wound is packed with gauze soaked in flavine and left to be closed at a later date. External operation is not indicated except when perforation has occurred.

If a foreign body passes the upper narrow parts of the œsophagus it will almost invariably slip through into the stomach and will pass along the intestinal tract in most cases without causing trouble.

When once the foreign body has passed into the stomach purgatives and emetics should be avoided and if not of large size and sharp or irregular shape the case is left to nature the treatment being merely expectant. The patient is kept quiet and fed on pulaceous food—such as brown bread porridge etc.—and the onward passage of the foreign body watched by radiography. Should it be large and its course arrested and especially if inflammatory symptoms occur a laparotomy for its removal must be undertaken promptly.

Inflammation of the œsophagus with or without ulceration is caused by swallowing corrosives or irritants and in a more localized

form by the impaction of foreign bodies. The symptoms are pain and difficulty in deglutition and the treatment consists in giving antidotes and olive oil in the restriction of the diet to liquids whilst in bad cases rectal feeding or gastrostomy may be necessary.

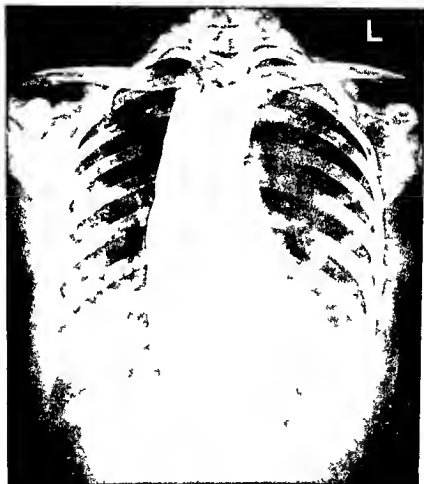


FIG. 623.—CARDIOPHAGUS.

Note the smooth conical outline of the constriction and also the dilatation and tortuosity of the œsophagus above it in contrast to the normal calibre of the œsophagus in FIG. 630.

Chronic Inflammation of the Mouth of the Œsophagus occurs in middle-aged women and may be followed by malignant changes. The symptom is dysphagia. Some cases are associated with chronic superficial glossitis and secondary anemia. The treatment consists in dilatation of the cricopharyngeal sphincter together with the

beyond the limits of the oesophageal walls takes place in advanced cases most often involving the trachea. The symptoms consist of gradually increasing difficulty in swallowing first for solids only and later for liquids as well. There is often a feeling of obstruction but pain is not present. Collection of frothy saliva in the pharynx worries the patient particularly as there is often overflow into the larynx with resulting



FIG. 630.—CARCINOMA OF OESOPHAGUS

Note the filling defect and the holding up of the barium column but there is no appreciable dilatation.

cough this symptom is most troublesome in cases where one recurrent laryngeal nerve is paralyzed because of inefficiency in lateral protection of the laryngeal aperture by the aryepiglottic fold. Should the growth be at the upper end of the tube pain may be referred to the ear and a tumour may be distinctly felt placed deeply in the neck and probably more marked on the left side in the earlier stages nothing can be felt

PLATE XIV



Carcinoma of the Oesophagus showing a perforation
(Museum, Royal College of Surgeons)

CHAPTER XXXI

SURGERY OF THE AIR-PASSAGES

By V. E. NEGUS M.S. F.R.C.S.

Examination of the Air Passages—1 Before the student can understand affections of the upper air passages it is absolutely essential for him to master the use of the *laryngeal mirror*. This consists of a circular mirror set at an angle on the end of a metal stem which is inserted into the patient's widely-opened mouth in such a way that it rests against and slightly elevates the soft palate. A beam of light is thrown into the mouth either from an electric head lamp on the surgeon's forehead or reflected by a frontal mirror from an electric lamp fitted with a lens. The patient's tongue held with a small cloth is drawn well forwards so as to enable the light to reach the larynx the image of which is seen in the mirror. Considerable practice is needed in order to attain any facility in the use of this instrument as also to be able to recognize normal from abnormal structures. The use of cocaine to anesthetize the fauces is in many cases indispensable. It must be remembered that the image is always inverted so that the anterior portion of the larynx appears behind but there is no reversal of the sides.

2 It is now possible to see the interior of the air passages by the use of the *bronchoscope* (Fig 632). This consists of a straight tube which can be introduced through the upper air passages under general anesthesia or after thorough cocaineization and can then be carried down to the bifurcation of the trachea and into one or other bronchus. By this means foreign bodies have been extracted from a bronchus on numberless occasions. Bronchoscopes with distal lighting of Chevalier Jackson's type are preferred by many while others use proximal lighting a mirror reflecting the light from a small electric bulb.

3 *Radiography* plays a considerable part in the diagnosis of affections of these regions. The presence and position of foreign bodies is of course determined by this agency the existence of growths in the lung can be ascertained. The movements of the diaphragm can be followed and the condition of the chest wall established. Pulmonary tuberculosis can be recognized at an early stage and the condition of the bronchial lymphatic glands noted it is sometimes possible to make out that the disease commenced in them and is affecting the pulmonary tissues secondarily. Radiography also enables the physician or surgeon to follow the effects of such proceedings as the establishment of an artificial pneumothorax or phrenic avulsion (p 984).

Lastly it is of use in the diagnosis of pulmonary cavities tuberculous or simple before or after the intratracheal injection of *lipiodol* (p 1024).

20 to 40 c c of this material in adults (a correspondingly diminished amount in children) may be introduced into the air passages either through the glottis or by puncturing the crico thyroid membrane. In either case the trachea must be previously anæsthetized by cocaine (5 per cent) or percaïne (2 per cent). The lipiodal must be well warmed as also the syringe and the patient must lean towards the side which is to be explored. Radiography should be undertaken at once. The patient must be warned against swallowing the material

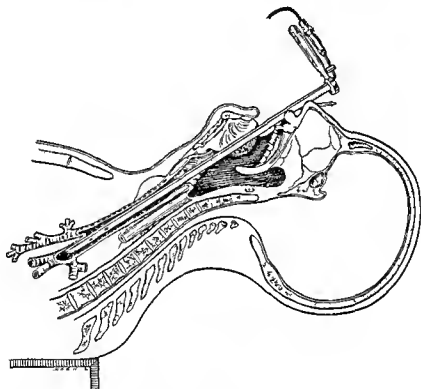


FIG 632 —CHEVALIER JACKSON'S BRONCHOSCOPE IN POSITION

The head of the patient is raised so as to bring the occiput to a position 10 cm above the level of the table. Half the scapula is off the table in Boyce's position as recommended by Chevalier Jackson.

expectorated soon after the injection. Very excellent and helpful results have followed this procedure. The solution may be introduced through a bronchoscope if desired.

Foreign Bodies in the Air-Passages—Any part of the respiratory tract may be partially or completely obstructed by the presence of some foreign body the effect of which may be of greater or less gravity according to the situation, character, and size of the intruding substance.

1 In the Nasal Passages (see p 986)

2 Obstruction occurring at the entrance to the larynx is due to attempts to bolt large masses of food which becoming impacted may cause immediate death. A person eating a meal voraciously turns black in the face and falls off his chair dead. A similar result has followed such a foolish act as attempting to swallow a billiard ball. If the obstruction is not complete as when a large denture becomes impacted dyspnoea is caused the symptoms rapidly increasing owing to œdema of the submucous tissue of the glottis. Accidents of a similar nature may occur during anaesthesia an epileptic fit or drunkenness substances such as a denture or a mass of vomited food blocking the entrance to the larynx. The Treatment must be prompt since there is no time to lose. The mouth should be forced open by the handle of a fork or anything suitable that happens to be near and the finger swept round the pharynx so as to dislodge the foreign body. Care must be taken not to push the object still further into the laryngeal aperture. Failing removal laryngotomy or tracheotomy must be performed and artificial respiration if necessary instituted. In less urgent cases there is time to remove the substance from the mouth by direct laryngoscopy.

3 In the Larynx.—A foreign body enters the larynx by inhalation during a deep respiratory effort when the glottis is widely open. Anything large is likely to be stopped above the larynx and hence the type of foreign body found in this region consists of small coins buttons nutshells or pins. Total obstruction may cause immediate death or the object may enter one of the ventricles and only produce partial obstruction as evidenced by a sudden sense of suffocation urgent dyspnoea and a violent attack of coughing attended perhaps by vomiting such as occurs when anything is said to have gone down the wrong way. After a preliminary bout of coughing little is felt and symptoms may be almost completely absent. Laryngoscopic examination should reveal the situation of the intruding body. The Treatment consists in removal through the mouth with grasping forceps passed through a direct laryngoscope the head of the patient being lowered to prevent the foreign body falling into the trachea if dislodged when not firmly grasped.

4 In the Trachea.—To lodge in this situation a foreign body must be small enough to pass through the rima glottidis and not too heavy otherwise it drops into one of the bronchi it may become impacted if it has jagged edges but usually remains free.

The Symptoms are obstruction irritation and inflammation dependent on the size and nature of the object. During the passage of the body through the larynx the patient suffers from a severe attack of spasmodic dyspnoea and coughing of temporary duration. Later on similar attacks may be induced if the foreign body be light and particularly if of a vegetable nature it is coughed up against the lower aspect of the vocal cords and death has even resulted from its impaction in the larynx brought about in this way. The irritation of this vegetable type of foreign body in the trachea produces acute tracheo-bronchitis with frothy expectoration and spasmodic cough.

Treatment consists in the introduction of a bronchoscope, so that the foreign body may be seen, and by suitable forceps secured and removed. If such appliances are not available, a low tracheotomy must be performed if dyspnoea is severe, particularly if the object is of vegetable nature. As soon as practicable the patient is conveyed to some centre where the foreign body can be removed by bronchoscopy.

5. To become impacted in a **Bronchus** the foreign body must be sufficiently small to pass through the rima glottidis and heavy and smooth enough to allow of its dropping down the trachea, the most common *non-vegetable* articles are buttons, pebbles, slate pencils, pins, an O'Dwyer's tube or the inner cannula of a tracheotomy tube. The right bronchus is more often obstructed, as it is more in a direct line with the trachea and is the larger. A series of symptoms similar to those already described manifests itself: viz. obstruction, irritation, and inflammation. The obstruction is twofold: immediate, as a result of the passage of the intruder through the glottis, a condition due more to spasm than to mechanical causes; and late, as a sequence of its lodgment in the bronchus. *Vegetable substances* like orange-pips and melon seeds, or pieces of nut may lodge in a main bronchus or one of the branches. In such a case irritative tracheo-bronchitis is present in addition to the signs of obstruction of part of the lung. The obstruction is at first partial, and more or less valvular in character, allowing entrance of air during inspiration, but preventing its exit. Obstructive emphysema of a lobe or a whole lung is thus produced. The swelling of the mucous membrane later makes it complete. Subsequent collapse of that portion of the lung supplied by the affected bronchus is induced, as indicated by dulness and the absence of breath-sounds. Vegetable substances produce such acute tracheo-bronchitis that they soon kill the patient if not removed, non-vegetable objects, on the other hand may lie in the lung for months or years without producing symptoms, but lung abscess or bronchiectasis, with purulent sputum, will appear eventually. Sometimes the abscess may extend through the lung substance to the pleura, setting up a localized empyema. In other cases multiple bronchiectases appear, and the patient dies of exhaustion.

Treatment.—It has now been abundantly demonstrated that except in cases where a foreign body lodges on the top of the larynx and causes immediate suffocation, it is possible to permit the patient to travel to some centre where expert help is available, if such assistance cannot be taken to the patient. After the first spasms of coughing the patient becomes more or less comfortable, and no immediate ill results arise, in the case of vegetable objects, however, œdema of the glottis may necessitate urgent tracheotomy. The foreign body is then carefully localized by examination of the lungs and X rays, and it is wise (as advised by Chevalier Jackson) to practise removal of a replica of the foreign body through the bronchoscope before dealing with the case by removal under direct vision, or, occasionally, under fluoroscopic guidance. Rare cases of deeply lodged foreign bodies, with considerable disorganization of the lung, call for lobectomy.

Injuries of the Larynx.—Several conditions arising from traumatism

of the upper air passages are described elsewhere *e.g.* fracture of the hyoid bone (p 573) and incised wounds as in cut throat (p 1077)

Occasionally the thyroid or cricoid cartilages may be injured or fractured by direct violence as in garroting causing local pain and hæmorrhage and possibly some obstruction to the respiration. As a rule no treatment is required beyond keeping the patient quiet but should symptoms of dyspnœa arise intubation or tracheotomy must be undertaken

Diseases of the Larynx

The study of laryngeal diseases can only be briefly referred to here since it is now so extensive as to require special textbooks



FIG 633—ŒDEMA OF GLOTTIS FROM BEHIND (RCS MUSEUM)

The base of the tongue is seen to be enlarged and swollen and the arytenoid epiglottidean folds are œdematous so that the entrance to the larynx is represented by a mere chink.

Simple Acute and Chronic Laryngitis are conditions of but slight surgical interest. The acute affection arises from bacterial infection and is characterized by aphonia (loss of voice) and cough. Locally the vocal cords are seen to be hyperæmic and swollen. The *Treatment* is rather medical than surgical.

Diphtheritic Inflammation of the Larynx (p 130) is usually met with as an extension of a similar affection of the fauces. It gives rise to severe dyspnœa from obstruction and if the condition does not yield to the injection of the diphtheritic antitoxin will require intubation or tracheotomy.

Acute Œdematous Laryngitis, or œdema of the glottis is a condition of considerable importance. *Causes*—(a) It is secondary either to some other laryngeal affection such as acute catarrhal laryngitis or acute perichondritis or more rarely to some chronic affection such as tubercle syphilis or carcinoma or (b) it may extend from inflam-

matory conditions of neighbouring tissues such as the root of the tongue or the submaxillary region *e.g.* in cellulitis or Ludwig's angina or it may be secondary to a retropharyngeal abscess. (c) It is also not unfrequently seen in children from drinking scalding water as from the spout of a kettle or sometimes in adults from swallowing corrosives. (d) It may result from the presence of a foreign body. (e) It has also

been known to occur as part of the general anasarca of chronic Bright's disease. *Characters*—The folds of mucous membrane extending on either side of the epiglottis both to the root of the tongue and backwards to the arytenoid cartilages become swollen and œdematous from a serous effusion into the submucous tissue (Fig 633). The same condition also involves the false vocal cords (superior thyro arytenoid folds) extending down as far as the true cords. The process is checked at this level owing to the absence of submucous tissue the vocal cords consisting of elastic fibres covered merely by a layer or two of squamous epithelium. The epiglottis becomes folded laterally upon itself as a leaf leaving only a valve like chink which permits of expiration although considerably checking inspiration. The *Symptoms* produced by this condition are those of dyspnœa not unfrequently aggravated by spasm of the glottis and this is sometimes of sufficient intensity to destroy the patient's life. There may also be some difficulty in swallowing owing to associated œdema of the pharynx and œsophagus and some degree of febrile disturbance. The diagnosis is made by laryngoscopic examination when the slit like opening of the glottis bounded below and behind by thickened œdematous folds of mucous membrane can be seen. *Treatment*—Relief may be gained by inhaling steam arising from hot water to which some tinct benzoini co has been added. Fomentations or ice compresses applied externally are also useful especially the latter. In very severe cases particularly in children tracheotomy may be necessary.

Syphilitic Diseases of the Larynx—In the *secondary* stage mucous tubercles or superficial ulcers occasionally form in the neighbourhood of the vocal cords. No special local treatment is required. In the *tertiary* period diffuse gummatous infiltration or localized gummata may develop giving rise to destructive ulceration which especially affects the epiglottis and aryteno epiglottidean folds and may spread and involve the boundaries of the glottis. Inflammation of the perichondrium is likely to follow leading to necrosis of the cartilages. Hoarseness and dyspnœa are the chief symptoms whilst considerable obstruction may be caused subsequently by laryngeal stenosis due to cicatrization. *Treatment* consists in the administration of iodide of potassium and mercury together with injections of salvarsan or one of its later substitutes. Should urgent dyspnœa arise tracheotomy must be undertaken. Tertiary syphilis of the larynx is at the present time very rare.

Tuberculous Laryngitis (Plate XV Figs 1 and 2) is almost always secondary to phthisis if no focus is present in the lungs deposits of lupus will be found in the nose or on the face. It usually commences at the posterior part of the larynx in the neighbourhood of the arytenoid cartilages as a submucous infiltration which later breaks down and leads to typical tuberculous ulcers similar to those occurring in other viscera (p 180). Considerable destruction of tissue ensues in advanced cases involving the posterior region of the larynx and even leading to perichondritis and necrosis of the cartilages. Hoarseness cough pain on swallowing and perhaps a certain amount of dyspnœa in a patient suffering from phthisis are the chief symptoms arising from

this affection the prognosis of which is always of a grave nature
Treatment—As for other tuberculous affections constitutional treatment is now mainly relied on and for choice in a sanatorium whilst absolute silence is insisted on. Occasionally local treatment is undertaken by the laryngologist in the form of applications of the galvano cauter. The earlier recognition of pulmonary tuberculosis and its more effective treatment is however reducing the number of cases of the laryngeal affection.

Paralysis of the Larynx is of surgical interest when arising from injury of the recurrent laryngeal nerve as in the removal of a goitre or from the pressure of aneurysms of the innominate artery or aorta tumours in the mediastinum or cancer of the œsophagus. Paralysis from the above causes is generally unilateral. The effect of complete paralysis of one recurrent laryngeal nerve is to produce total immobility on the affected side of the vocal cord which lies in what is known as the cadaveric position i.e. midway between that in which it is placed during phonation and during inspiration. When due to pressure on and not section of the nerve the abductor fibres are always involved first leading to unopposed action of the adductor muscles resulting in serious dyspnoea in bilateral cases. The *Symptoms* arising from unilateral recurrent paralysis are usually slight the voice being but little modified as the healthy cord is capable of passing across the middle line. If however both sides are completely paralyzed absolute aphonia with dyspnoea results but if only the abductors are involved the voice may be unimpaired although severe dyspnoea is present and this may prove fatal unless tracheotomy is promptly performed.

Papilloma of the Larynx (Plate XV Fig. 4) occurs in children in the form of wart like masses growing from the vocal cords and giving rise to considerable hoarseness and perhaps some dyspnoea. They are recognized on indirect laryngoscopic examination and in adults may be removed successfully by laryngeal forceps after the parts have been efficiently cocaineized. It is better however to employ the direct laryngoscope as with special tubes and forceps it is possible to obtain a clear view of the parts and to remove the growths with precision and accuracy. In children direct laryngoscopy is the only possible method. The same remark holds good for cysts or other innocent tumours of the larynx (Plate XV Fig. 3).

Epithelioma of the Larynx occurs in elderly patients much more frequently in males as a papillary overgrowth usually on the anterior third of one vocal cord (Plate XV Fig. 6) (intrinsic type). It may also commence on the epiglottis aryepiglottic fold or on the posterior surface of the cricoid cartilage (extrinsic type). The tumour gradually spreads both superficially and deeply and may eventually invade the cartilages giving rise to necrosis. At a later stage it extends beyond the limits of the larynx attacking the base of the tongue œsophagus and the lateral walls of the pharynx. The growth in early intrinsic cases is unilateral causing hoarseness and aphonia. As long as the disease is strictly limited to the interior of the larynx (intrinsic cancer) there is but little tendency to affection of lymphatic glands. When



1



2



3



4



5



6

Diseases of the Larynx

- 1 Tuberculosis involving posterior extremities of vocal cords and in arytenoid region
- 2 Advanced tuberculosis with ulceration of vocal cord and swelling of aryteno-epiglottic fold
- 3 Mucous cyst in vallecula
- 4 Simple papilloma
- 5 Extrinsic cartilaginous noma on aryteno-epiglottic fold
- 6 Intrinsic cartilaginous noma on vocal cord

involvement of numerous glands its total extirpation may not be practicable and all that can be done is to treat symptoms as they arise and perform tracheotomy when necessary. The treatment of post-cricoid growths is referred to on p 1023.

Acute and Chronic Perichondritis usually end in the formation of an abscess and in necrosis of the cartilage involved. The *acute* variety is pyogenic and due to traumatism—sometimes as the result of high tracheotomy—or to auto-infection following acute fevers such as typhoid. The patient complains of severe pain and tenderness over the larynx with fever dysphœsia and hoarseness. Dyspnœa results from swelling of the mucous membrane and œdema of the glottis may follow. An abscess may point internally or externally and on opening it the cartilage will usually be felt bare and perhaps necrosed. *Treatment* in the early stages consists in fomentations but when the affection is producing dyspnœa and an external swelling is present it is well to cut down on the cartilages from outside. Should this fail to relieve the dyspnœa tracheotomy will be required. The *chronic* variety is more often due to tubercle syphilis or carcinoma in it an abscess forms more slowly and with less constitutional disturbance but necrosis ensues none the less. When the abscess points externally it should be opened. When a well marked sequestrum is present it must be removed by an external incision and if need be thyrotomy must be undertaken. Distortion or stenosis of the larynx is not an unusual sequela possibly necessitating the perpetual use of a tracheotomy tube.

Operations upon the Air Passages

1 **Subhyoid Pharyngotomy** was devised by Malgaigne in order to provide access to the upper parts of the larynx. A transverse incision is made through the thyro-hyoid space the pharynx is opened and the epiglottis detached from the base of the tongue (Fig 634). It is a proceeding that is seldom undertaken but may be necessary for the removal of certain neoplasms.

In **Transhyoid Pharyngotomy** the hyoid bone is divided in the middle line through a vertical incision extending from the symphysis menti to the thyroid cartilage. The pharynx can then be opened either above or below the level of the hyoid bone and the back of the tongue the posterior wall of the pharynx or the upper part of the larynx exposed. A preliminary tracheotomy is of course necessary.

Neither of these proceedings is very satisfactory in that they provide very little room unless the lower jaw and tongue are divided in the mid line. In **Lateral Transthyroid Pharyngotomy** the ala of the thyroid cartilage is removed through a lateral incision along the anterior border of the sterno-mastoid enabling the surgeon to define more accurately the limits of the disease and by opening freely the pharynx to remove a growth on the aryepiglottic fold or lateral border of the epiglottis together with the lymphatic area involved. Of course a preliminary tracheotomy is necessary and various remedial operations to make

good the defects caused by the removal of the pharyngeal wall. These and the needful preparation and after treatment are too lengthy to be described here.

2 **Thyrotomy (Laryngo-Fissure)** consists in the median vertical section of the thyroid cartilage (Fig. 634) and may be used for the removal of tumours of an innocent nature or of a localized cancer of the vocal cord (intrinsic). An incision is made in the middle line from the upper border of the thyroid cartilage to the suprasternal notch. Tracheotomy is performed either below or at the level of the isthmus of the thyroid gland; in the latter case the isthmus is of course divided. The thyroid cartilage is stripped bare of its perichondrium on the side of the growth and then by means of special saw and shears is cut through from below upwards. The outer blade of the shears is made to cut the cartilage a little to the opposite side to give a better clearance; the inner blade plunged through the crico-thyroid membrane enters the glottis from below and being kept rigidly in the middle line neither injures the growth nor damages the vocal cord and other tissues on the sound side. Held open with retractors the trachea is plugged above the tracheotomy tube and then the vocal cord and ventricular band with the underlying muscles and perichondrium are stripped off the thyroid ala as far as necessary even on to the cricoid ring. The ala thus separated is then removed to give easier access to the interior of the larynx. Using specially curved scissors three cuts only are needed to remove the tumour: one through the aryepiglottic fold, a second below the vocal cord and the third behind the growth taking away a small portion of the vocal process of the arytenoid. The growth is thus removed completely with a sufficient area of healthy tissue around it. Any bleeding is controlled, the tracheal plug is removed, the tissues are accurately sutured together, and a dressing applied. The tracheotomy tube is removed after eight to twenty-four hours.

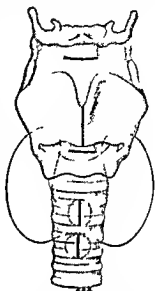


FIG. 634

The hyoid bone is seen above with the thyro-hyoid membrane extending from it to the thyroid cartilage; a transverse incision is shown in the membrane as for subhyoid pharyngotomy. A vertical incision in the centre of the thyroid cartilage represents the position of laryngo-fissure. Through the crico-thyroid membrane a transverse incision indicates where laryngotomy is performed. The trachea with its rings is shown partly covered by the isthmus of the thyroid gland; the positions of tracheotomy openings through the second and third and fourth and fifth rings are shown by vertical lines; dotted circles representing the disc removed before insertion of the cannula.

This method of treating intrinsic cancer of the larynx has been

brought into great prominence and favour by the work of Sir St. Clair Thomson and the after results have proved most successful the patient being able to speak clearly

3 **Extirpation of the Larynx (Complete Laryngectomy)** is never undertaken except for malignant disease and then as a rule only when it involves both sides. So long as the growth is intrinsic there is hope of a good result but when it has spread beyond the laryngeal limits the prognosis is much worse and the ultimate mortality is greatly increased. In favourable cases although the patient loses all power of normal phonation yet he can speak with his

œsophagus or can cause a reed to vibrate while articulating with the mouth and lips. Improved methods of diagnosis and increased facility on the part of practitioners in the use of the laryngoscope are bringing the patients for operation at an earlier date and laryngo fissure is much more frequently employed than formerly. Into the details of a complete laryngectomy it is unnecessary to enter here larger textbooks on operative surgery must be consulted. It must suffice to state that a skin flap with its base above is turned up and the larynx freed in front and laterally. The thyrohyoid membrane is cut through and the larynx is removed from above down being cleared from its attachments to the constrictors. The trachea is cut across below the first ring on the slant so as to enable its margins to be stitched to the edges of the skin thus establishing a permanent opening.



FIG 635.—LARYNX OF AN ELDERLY MAN WITH AN EXTENSIVE CARCINOMA ON THE RIGHT SIDE AND A SMALL NODULE ON THE LEFT

The patient suffered from glycosuria but survived the operation of complete laryngectomy. Several months later recurrence took place in glands in one side of the neck these were removed by block dissection. Three years later the patient was quite well.

The rent in the mucous membrane of the pharynx is closed by sutures the divided muscles are drawn together and the skin incision closed with provision for free drainage. It is possible sometimes to secure healing by first intention. If the disease has spread beyond the laryngeal limits the operation must be suitably modified and becomes increasingly difficult and dangerous.

4 **Laryngotomy** is rarely undertaken except for the relief of dyspnoea arising from some sudden obstruction to the respiration and is thus to be looked on as an operation of urgency. It is a rare alternative for tracheotomy in cases where the entrance to the larynx is obstructed by a foreign body for spasm of the glottis or for accumulations of blood in the neighbourhood of the larynx during an operation. It is

readily performed by making a vertical incision over the situation of the crico thyroid membrane which is then divided transversely along the upper border of the cricoid cartilage the sterno hyoid muscles being if necessary drawn aside and a tube inserted Whenever there is time to operate deliberately tracheotomy is the better practice since a tube inserted through the crico thyroid space gives rise to considerable irritation and the voice may be modified by the contraction of the cicatrix A special tube is required the lumen of which is not circular but oval and flattened from above downwards

5 **Tracheotomy**—The trachea consists of from sixteen to twenty rings of which six or seven are situated above the sternum The isthmus of the thyroid body generally covers the third and fourth rings the trachea may be opened either above or below it or behind the isthmus which is if necessary divided or pushed up or down Tracheotomy is required in any condition in which there is serious obstruction to the respiration occasionally for oedema of the larynx and often for diphtheria for stenosis tumours and some forms of paralysis of the larynx occasionally before the removal of foreign bodies or for compression of the larynx or trachea by external tumours such as a malignant thyroid gland It is also undertaken as a preliminary measure in operations on the mouth tongue pharynx or larynx in which there is any likelihood of asphyxia or secondary septic pneumonia owing to the entrance of blood or septic discharges into the air passages If tracheotomy is performed too near the larynx there is great danger of perichondritis followed by death or of laryngeal stenosis due to obstruction or to fixation of the arytenoid cartilages because of arthritis in their joints with consequent loss of movement of the vocal cords in such a case the tracheal cannula must be worn permanently Therefore the opening should never be so high as to injure the cricoid cartilage nor to divide the first ring of the trachea it should be at the level of the third fourth or fifth rings of the trachea the isthmus of the thyroid gland being pushed down or divided in the former case and pushed up in the latter The former distinction between high tracheotomy above the isthmus and low tracheotomy below it loses meaning as the arbitrary boundary fixed by the gland can be ignored A patient should however never be allowed to die of asphyxia because the operator finds difficulty in opening the trachea low down air should be let into the wind pipe at all costs but as soon as tranquil respiration is established a second opening should be made well away from the larynx and the cannula transferred

The operation is performed as follows The patient is placed on the back with a sandbag or pillow beneath the neck so as to throw the head backwards and put the structures on the stretch and with the shoulders somewhat raised Anaesthesia may be induced by chloroform or ether but it is usually wiser to employ local infiltration The head is held exactly in the middle line, and the surgeon feels for and identifies the cricoid cartilage The incision extends from the top of the cricoid cartilage to the top of the sternum The superficial fascia is divided and the interval between the sterno-hyoid and sterno-thyroid

muscles made out so as to enable them to be separated one from the other. The edges of the wound are drawn aside by blunt hooks which should both be held by one assistant so as to ensure equable traction.

The isthmus of the thyroid gland should be pushed either up or down after the fascia along its lower or upper border has been transversely incised; if this is impracticable it is divided and ligated. The trachea is thus clearly exposed and should be fixed and steadied by inserting a sharp hook into the lower border of a tracheal ring. The wound is freed from blood and after the injection of about 5 minims of 2½ per cent cocaine—except in very urgent cases—the trachea is opened by cutting through one of the rings from below upwards, a complete disc being removed sufficiently large to admit of the introduction of the cannula unless the urgency of the case prevents this refinement. A deep inspiration is usually taken at once with or without coughing and if the operation is undertaken for diphtheria the surgeon must be careful not to let any membrane which may then be expelled enter his eyes, nose or mouth. The insertion of the tube is in many cases easy—particularly if a disc has been removed; in others it is a matter of some difficulty. Anything which suffices to separate the lips of the tracheal incision, e.g. the handle of a scalpel introduced and turned, a couple of hooks or dressing forceps will form an efficient guide for this purpose. The breathing soon becomes quiet and regular and the tube is fixed in position by tapes passed through lateral openings in the face plate and tied round the neck. No dressing is required for the wound except a few layers of gauze beneath the plate.

When very low tracheotomy is performed the inferior thyroid veins come into view and may cause trouble if they are distended with blood as is so frequently the case in patients suffering from dyspnoea. They must be held aside by hooks or divided between ligatures and the deep layer of fascia behind them incised so as to expose the trachea which is cleared, fixed and opened in the same way as described above. The left innominate vein may be in danger and occasionally the innominate artery also may be near the zone of operation.

Many different forms of *tracheotomy tube* have been used from time to time but the essential elements of which it consists are a double cannula, the inner portion of which can be readily removed and cleansed; it should always be longer than the outer in order to prevent any plug of mucus being left within the outer tube on removal of the inner. A face-plate (E) or some similar contrivance is attached to the outer cannula (A) in order to fix and steady it. One of the best is that known as *Durham's tube* (Fig. 636) it is set at right angles and has a lobster tailed inner tube; its removal and replacement require a little skill. In cases of properly performed low tracheotomy a cannula made in the form of the arc of a circle is very satisfactory; the type recommended by Chevalier Jackson is excellent. Whatever variety of tube is preferred by the surgeon it is essential to have several sizes to hand as the calibre of the trachea and the depth at which it lies vary much in different patients.

Difficulties and Dangers of the Operation—Although the above description might lead the student to suppose that tracheotomy is an easy operation this is by no means always the case partly owing to the fact that it frequently has to be undertaken in a hurry with perhaps inefficient assistance and in a bad light and partly owing to the intense vascular engorgement of the structures met with. A cool head and a steady hand are in such cases of infinitely greater value to the operator than the most perfect anatomical knowledge. The following are the chief conditions which may lead to mistakes and accidents.

(1) It is not always easy to find the trachea especially in the necks of fat children, or where it is hidden by an unduly large thyroid isthmus or possibly by the projection of the thymus gland into the neck. It is here most essential to remember the old adage *In medio tutissimus ibis* although occasionally the trachea may be displaced from the middle line by some external growth and can then only be found by careful exploration with the finger.

(2) *Hæmorrhage* is generally troublesome. It is usually venous in character, arising either from the anterior jugular vein or from the inferior thyroid plexus. If possible it should be controlled by pressure forceps before opening the trachea, but this is not absolutely necessary in urgent cases since it usually ceases as soon as easy respiration through the tube has been established. The presence of the left innominate vein in front of the trachea must not be forgotten although it but rarely reaches above the sternum. In about 8 per cent of all subjects an arterial twig (the *thyroidæ ima*) courses upwards from the innominate artery along the trachea to reach the isthmus of the thyroid body, if divided, it can easily be secured and tied. Should much blood be inspired, it may determine the occurrence of septic pneumonia at a later date.

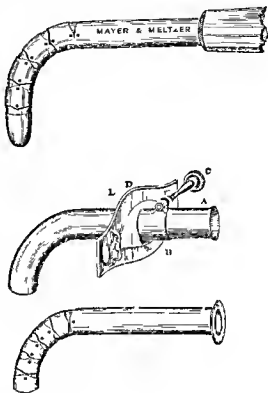


FIG 636—DURHAM'S LOBSTER TAILED TRACHEOTOMY TUBE WITH INTRODUCER ABOVE AND INNER TUBE BELOW

(3) The possibility of the *entrance of air into veins* must not be overlooked although it is an uncommon accident since the intravenous pressure is usually increased.

(4) Not unfrequently considerable mischief has been done by an *un cautious use of the knife* especially if the operator forgets to fix the trachea with a sharp hook before opening it. The knife should always be entered with its back towards the episternal notch and the incision made from below upwards. In a child the trachea is small, and if it is moving rapidly up and down as happens in urgent dyspnoea or if the child is restless and not completely under the influence of an anæsthetic the difficulty is manifestly increased. Many accidents have happened from this cause e.g. wounds of the large veins or arteries of the neck or even of the œsophagus or bodies of the vertebrae.

(5) As soon as the trachea is opened or an attempt made to introduce the tube a severe fit of *coughing* is induced which is sometimes so prolonged as to interfere with the introduction of the tube. This can be almost entirely overcome by introducing with a hypodermic syringe a few drops of a 2½ per cent solution of cocaine into the trachea before it is incised.

(6) The *introduction of the tube* is a matter of no difficulty if the surgeon takes the precaution of not removing the hook until this is satisfactorily accomplished. Many mistakes have followed the non observance of this rule thus the tube has missed the trachea altogether, and passed into the fascial interspace in front as also to one or other side the outer portion of a bivalve tube has often been passed with one limb within the trachea and the other outside. A very dense diphtheritic membrane has also been a cause of difficulty, in that although the tube has been really passed into the trachea it has not penetrated the membrane and thus has hindered rather than helped the breathing. In all cases of diphtheria the trachea should be freely opened and the interior carefully examined by separating the lips of the incision before attempting to insert the tube.

After-Treatment—The patient is placed in bed in a room kept at a uniformly warm temperature (75° F). Draughts are excluded by curtains and nothing except a thin veil of gauze should be placed over the entrance to the tube so that respiration may not be hindered nor the expectoration of mucus false membrane etc prevented. One of the most frequent sources of extension of diphtheria to the lungs or of septic pneumonia is the re inspiration of material which has been coughed out upon a portion of muslin or gauze placed with excellent intentions over the mouth of the tube. A nurse should be in constant attendance on the patient in order to wipe away all such material as it is expelled. If a suction pump is available it will be found most useful for removing secretions.

The inner portion of the tube is removed by the nurse and cleaned two or three times a day any inspissated mucus upon it being readily removed by the use of a solution of bicarbonate of soda (20 grains to 1 ounce). The outer tube is also removed for cleansing purposes but only by the medical attendant it does not require changing sooner than fourteen days after insertion. Should the respiration become

impeded by a collection of mucus in the trachea, a rubber catheter connected to a suction pump will be of great assistance in clearing the passages

The period for which the tube is kept in position varies, but its removal should always be undertaken at as early a date as possible, for fear of leading to impairment of the voice. Before removal of the cannula the inner tube should be closed with a cork at first partially and then completely, to accustom the patient to breathe once more through the larynx. Specially made holes in the outer cannula and inner tube of some types enable normal respiration to be performed with ease

After-Complications of Tracheotomy—(a) The tube may give rise to ulceration of the trachea if it is not correctly shaped. Thus if too much curved, it irritates the anterior wall and may cause death by perforation of the left innominate vein. If insufficiently curved the posterior wall may become ulcerated and the œsophagus laid open. In cases where a tracheotomy tube has to be worn for long, it should be made of silver

(b) Septic troubles may arise in the wound, leading to cellulitis and even secondary hæmorrhage, they are especially dangerous in the low operation, since they may extend to the mediastinal tissues. If the skin incision is long and has been left open this complication should never arise. In cases of diphtheria the wound may also become affected with the disease

(c) Inflammation of the trachea, bronchi, and lungs may result either from the entrance of cold or unmoistened air or from the inspiration of septic or diphtheritic material

(d) Difficulty is sometimes experienced in leaving off the tube, owing to the presence of granulations obstructing the lumen of the trachea, or to stenosis of the trachea or larynx, or even to paralysis of the abductor muscles especially in diphtheritic cases. The usual cause is too high a tracheotomy causing perichondritis, arthritis of the crico-arytenoid joints and fixation of the vocal cords. The trachea may also be kinked, and its calibre thus diminished, by cicatricial union of the skin and mucous membrane. The diagnosis of the cause at work in any particular case can only be made by laryngoscopy, or careful examination of the wound and upper portion of the trachea. Granulations round the mouth of the cannula may be scraped away or destroyed by caustics. Stenosis of the larynx may be overcome by dilatation. Stenosis of the trachea may require plastic reconstruction, whilst laryngeal paralysis must be treated by the use of electricity. The point of importance is to avoid these difficulties by insisting on low tracheotomy, or if this is not feasible during the time of urgency, by replacing a high placed cannula by one lower in the trachea within a few hours

(e) Finally, it should be remembered that if a patient (and especially a boy) is condemned to the perpetual use of a tracheotomy tube, he must be warned of the possibility of water getting into the trachea during bathing and of his being drowned thereby

6 Intubation of the Larynx consists in the passage through the

mouth of a suitably curved tube into the larynx by means of a specially contrived introducer. The best patterns to employ for the purpose are those known as O Dwyer's tubes. The lower end of the cannula is oval and not circular and passes between the cords into the trachea whilst the upper enlarged end lies over the laryngeal aperture; it requires changing frequently in order to prevent erosion of the mucous membrane. It has been used with considerable success in cases of oedema of the glottis and laryngeal stenosis but is not to be recommended for diphtheria owing to the risk of carrying the false membrane down with it. Tracheotomy is to be preferred in all cases of laryngeal obstruction.

CHAPTER XXXVI

SURGICAL AFFECTIONS OF THE LUNGS, PLEURAL CAVITIES, AND MEDIASTINUM

Pleural Effusion is the commonest surgical manifestation of a diseased pleura and may be either serous sero-fibrinous or suppurative. A *chronic* serous effusion is nearly always due to tuberculous disease of the lung or to mediastinal conditions causing pressure such as aneurism or new growth. *acute* serous effusions almost always go on to a supuration giving rise to an empyema. Where there is a new growth of the lung involving the pleura or where the pleurae are studded with small secondary growths an effusion occurs which is blood stained and from which cells from the growth can frequently be obtained.

Treatment—When the effusion is tuberculous in origin and not producing marked pressure symptoms it is probably best to leave it alone but if the lung is completely collapsed and the mediastinum displaced to such a degree as to embarrass the heart's action then aspiration repeated if necessary with air replacement should be undertaken.

In cases when the diagnosis of the type of effusion is doubtful an exploratory aspiration should be undertaken over the point of maximum dullness and where breath sounds are most completely absent. If a purulent fluid is found only sufficient for diagnostic purposes should be withdrawn.

When purulent fluid is found either free in the pleural cavity or encysted the condition is known as **empyema**. Such a collection of pus may be due to underlying disease of the lung the commonest causes being pneumonia either of the lobar or broncho-pneumonic type or it may be due to the spread of infection from the mediastinum or through the diaphragm from abdominal suppuration such as a sub-phrenic abscess. Infection is also said to occur through the blood stream but in all probability these cases have some small lesion of the lung from which the disease has extended. Infection may also be carried directly to the pleural cavity through an external wound. In phthisis a tuberculous empyema may be found. An empyema can occur at any age but at the extremes of life the condition is much more serious and especially in infancy.

A description of the physical signs and symptoms belongs to the physician rather than to the surgeon. It will suffice to mention here that in a total empyema the affected side of the chest does not move on respiration whilst the intercostal spaces may bulge on percussion the side is dull except perhaps immediately below the clavicle where tympanic resonance (skodaic) may be elicited. On auscultation

breath sounds are absent except in the vertebral groove where bronchial breathing may be heard. The loss of vocal fremitus is also an important sign. A certain amount of fever and dyspnoea is usually present the latter being dependent to a large extent on the rapidity with which the empyema has formed. leucocytosis is well marked and the heart and other viscera may be displaced. Left to itself a large empyema may find its way to the surface usually through the second interspace in front along the large perforating vessels (*empyema necessitatis*) and if situated on the left side may have transmitted to it pulsations from the heart and great vessels (*pulsating empyema*). In the case of a smaller empyema the pus may burrow through the lung open into a bronchus and be coughed up a natural cure resulting. When the pus is limited to certain areas special names are given to the empyema

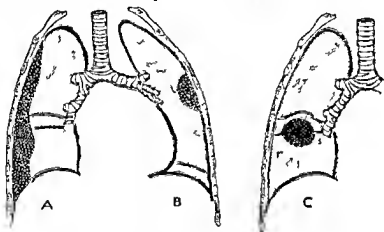


FIG 637

A Large empyema B Small localized empyema C. Interlobar empyema

such as apical when localized at the apex and interlobar when occurring between two lobes (Fig 637)

In the early stages of the disease the pleura is but little altered in structure although a certain amount of lymph may be deposited on it as the disease progresses this layer of lymph is increased and more especially so in the type due to the pneumococcus. Organization takes place in the deeper layers and at the same time fibrosis occurs in the periphery of the affected portion of the lung while occasionally an area of softening or an abscess cavity can be seen in the superficial lung substance. In old standing chronic cases the pleura becomes dense and firm owing to the development of fibro-cicatricial tissue whilst the surface is converted into a layer of granulation tissue similar to that found in all chronic abscesses. As the fluid increases in the pleural cavity the lung collapses before it at first its alveolar texture remains unaltered and with removal of the fluid re-expansion takes place. In chronic cases however this re-expansion

is hindered by the thickening and density of the visceral pleura which resists the atmospheric pressure and the fibrotic changes already mentioned which take place in the lung itself

Under these circumstances when the exudate is drained away the lung remains collapsed (*chronic empyema*) and nature then attempts in several ways to remedy the defect and obliterate the cavity (a) Emphysematous changes take place in the other lung and the mediastinum is displaced to the affected side (b) The chest wall becomes flattened and there is a compensatory scoliosis (c) The diaphragm tends to be pushed up by the abdominal viscera and (d) there is an exuberant growth of granulation tissue from the surface of the empyema cavity

In a certain proportion of cases the cavity although reduced in size still remains lined with a thickened pyogenic membrane and discharging pus Under these circumstances evidences of chronic septic absorption manifest themselves including clubbed fingers hypertrophic osteo arthropathy secondary anæmia etc and extensive operative interference is then necessary to remedy the condition

The Diagnosis of empyema is usually readily made by attention to the history and physical signs confirmation of such an opinion being obtained by puncture with a sterilized exploring syringe under local anæsthesia If pus is found only sufficient for diagnostic purposes should be withdrawn A medium sized needle should always be employed for this purpose and it is well to insert it along the top of a rib after drawing the skin up or down so that on removal a valvular puncture results The character of the pus will be a valuable guide to the treatment to be employed If the pus is thin and runs readily or if offensive in odour the likelihood is that the infection is a mixed one and the empyema under these circumstances is not limited by adhesions (*pyothorax*) if on the other hand difficulty is found in aspiration and the pus thick and flaky the probability is that a pneumococcal infection is present and that it is localized The previous clinical course of the case will also help in the diagnosis between a pneumococcal and streptococcal infection A bacteriological examination should be made to confirm these facts

Prognosis depends much on this point Thus an empyema due to pneumococci usually runs a mild course and is sometimes cured in the early stage by aspiration alone one due to the ordinary pyogenic cocci is more acute especially in the presence of a hæmolyzing streptococcus The presence of tubercle bacilli renders the outlook more doubtful whilst a mixed infection is always a serious complication

Treatment—If a streptococcal or mixed infection is found aspiration of the pus should be undertaken at intervals until such time as the pus thickens in character when open drainage can be performed It is found that this form of treatment of pyothorax gives greatly improved results since it allows time for the formation of adhesions fixation of the mediastinum and the localization of the pus whilst the patient is relieved of large quantities of toxin and the embarrassment of the heart from pressure effects is remedied If a pneumococcal infection is present aspiration alone is satisfactory if it can be carried out usually however it fails from the fact that the needle becomes rapidly

blocked with lymph, and then the pleural cavity must be freely opened. Where a double empyema is present, an open operation should be performed on the worst side, and aspiration on the other, until such time as the patient's condition also allows open drainage to be effected on this side.

The operation of opening the pleural cavity is best done under local anaesthesia or gas and oxygen. It is usually necessary to resect a portion of rib subperiosteally, though some surgeons prefer an intercostal drainage. The site chosen should correspond to the lowest level of the pus or be so placed as to secure the best drainage, usually in a complete empyema the eighth rib is the most suitable for excision, and this should be done in the posterior axillary line. It should be remembered that an adequate opening is essential in order to allow the surgeon to view the cavity and clear out the large fibrinous masses that are so frequently present. In a certain number of early pneumococcal cases after evacuating the pus and cleansing the cavity, the incision may be closed without drainage should a rise of temperature from re-accumulation occur later, aspiration will probably suffice.

In a large number of pneumococcal and in all mixed infections drainage must be undertaken, and this is best effected by introducing three short portions of tube side by side, which only just enter the cavity. Such adequate drainage will in the pneumococcal cases allow the removal of the tubes in four to five days, but in the mixed infection cases the time will be longer. Some surgeons maintain that the drainage of the pleural cavity should be by the 'closed' method. This is effected by a single flanged tube (Tudor Edwards) introduced into the cavity and led off to a bottle by the side of the bed, the end of the tube is below the level of an antiseptic solution, and some degree of negative pressure is thus produced, helping to re-expand the lung.

If operation is performed early and is adequate, re-expansion of the lung will always occur. It should be assisted by breathing exercises undertaken by the patient, such as blowing bubbles or water from one Wolfe's bottle to another, or forced expiration with the glottis closed, such as occurs while straining at stool. In a certain number of cases the lung will fail to expand and while the soft parts heal an intrapleural cavity is left (*chronic empyema*) with a chronic discharging sinus. The causes are to be found in delayed treatment of the empyema, inadequate drainage or sometimes too long a period of drainage, whilst occasionally tubes, safety pins, and pieces of gauze are lost in the cavity during some period of the treatment. The presence of a small bronchial fistula may also keep a chronic infection while in a certain proportion a sinus is present due to necrosis of the divided rib. In such cases an X-ray examination should be made after the cavity has been filled with lipiodol its extent can then be determined, and the necessary procedure adopted.

If the cavity is small the sinus should be opened up and the overlying ribs removed to a sufficient extent to allow complete exposure of the interior. Two drainage tubes are introduced, and round them are packed gauze soaked in some antiseptic. Dressings are renewed daily, and the wound allowed to heal from the bottom by granulation. The

cavity is thus obliterated by three factors the local falling in of the chest wall its replacement by granulation and fibro cicatricial tissue and to a certain extent by expansion of the lung In the case of large cavities this procedure is not only too severe but is inadequate Where the cavity is very large and the lung shows no signs of expansion a paravertebral thoracoplasty should be undertaken This in the majority of cases is highly successful and even when a cavity still persists it is usually so reduced that a local operation such as is described above may be performed at a later date Roberts has recently introduced an operation for the large empyema cavities where the ribs over the cavity are removed and the thickened parietal pleura is divided posteriorly The flap thus formed is lunged anteriorly and is kept in close apposition with the visceral pleura by means of outside packing thus obliterating the cavity Where the X ray picture shows a bronchial fistula this should *first be closed* before any other operative procedure is attempted The fistula in the lung is exposed by following the sinus and removing portions of the ribs in its neighbourhood this allows mobilization of the affected area of lung A collar of the thickened visceral pleura is then cut round the sinus and the edges sutured with catgut a further row of sutures being inserted in order to bury the first row drainage should be maintained by a tube through a separate stab wound and the original wound sutured *Decortication* of the thickened visceral pleura has been advocated in these cases this consists in exposing the cavity and stripping the thickened visceral pleura from the lung a severe procedure associated with considerable shock to the patient and oozing from the stripped surface with added danger of fresh sepsis from the injured lung A less severe operation consists in making incisions in the thickened visceral pleura in a cross hatch manner this allows the lung to expand by stretching the cut pleura These methods do not give such good results as the procedures already advocated

Tumours of the Pleura are rare apart from the multiple malignant nodules secondary to primary growths elsewhere Endotheliomata occur but are seldom correctly diagnosed When arising from the parietal pleura they compress the lung but do not invade it in the same manner as endothelioma of the dura mater pushes into the brain If not too extensive they can be removed together with the overlying ribs

Hydatid Cysts of the pleura also occur but call for no special mention

Surgical Affections of the Lungs

Non penetrating Wounds of the Lungs result from violence applied to the chest with or without fractures of the ribs and consist either of laceration or contusion

Contusion of the Lung often follows an injury which is not sufficiently serious to break the ribs The symptoms produced are severe pain in the side with slight shock and hæmoptysis Some traumatic inflammation follows both of the lung and of the pleura as indicated by loss of resonance and possibly friction sounds The Treatment consists

in keeping the patient quiet in a warm room and regulating the bodily functions. Pain is often relieved by strapping the side of the chest.

Laceration of the Lung is usually due to fracture of the ribs by direct violence. The severity of the symptoms necessarily varies with the character and extent of the injury. In bad cases the patient suffers from marked shock, pain and dyspnoea. Evidences of hæmorrhage soon follow either in the form of hæmoptysis or hæmothorax. If the wound is small the patient complains of an irritating cough and brings up a good deal of blood stained frothy mucus but if the laceration is extensive involving the larger vessels a quantity of pure blood may be ejected even leading to death from syncope or from asphyxia owing to the blood filling the larger bronchial tubes. Hæmothorax may also be well marked it results in a gradually increasing area of dulness extending from below upwards together with loss of breath sounds and vocal fremitus coming on soon after the injury without signs of inflammation. Left to natural processes the blood will be gradually absorbed but it is likely to cause many adhesions and much impairment of respiration. Infection may occur secondarily either from the blood itself or from infected foci in the lung.

Owing to the laceration of the pulmonary vesicles air may escape either into the pleural cavity giving rise to the condition known as pneumothorax or into the cellular tissue of the body constituting surgical emphysema. Pneumothorax is always associated with more or less collapse of the lung and if complete or produced suddenly is almost certain to lead to considerable interference with respiration and possibly to severe dyspnoea or even orthopnoea. A slight degree of pneumothorax or a complete one if produced slowly has but little functional result if the other lung is healthy and no strain is thrown upon it. The air which finds its way into the pleura in connection with a ruptured lung having filtered through the pulmonary alveoli is free from organisms and hence does not cause suppuration or putrefaction of the blood-clot present unless bronchitis or some other suppurative condition has existed previously. The physical signs of pneumothorax consist in a high pitched tympanic note on percussion and on auscultation amphoric breathing and possibly metallic tinkling. As soon as the wound in the lung commences to heal the amphoric sounds disappear the effused air is absorbed and the lung gradually expands a process which may take four or five days. If blood is present in the thorax a condition of hæmo-pneumothorax is produced recognized by a splashing or succussion sound heard on shaking the patient. Surgical Emphysema indicates a wound of both pulmonary and parietal layers of the pleura which are slightly separated by air constituting a localized pneumothorax. At each inspiration a fresh amount of air enters this cavity and is expelled into the areolar tissues through the parietal wound at each expiration being forced perhaps to a considerable distance from the spot where it commences or even spreading over the whole body. It is of no serious significance unless extensive disappearing rapidly after the wound in the lung has commenced to heal thus occluding the opened pulmonary alveoli. It is recognized by the parts becoming swollen and puffy and giving a sensation of fine crackling

crepitus when the hand is pressed over them. Occasionally emphysema may arise as an *interstitial* condition, when the parietal pleura has not been injured, the air escaping from the alveoli along the inter-alveolar connective tissue into the root of the lung and then appearing first at the lower part of the neck.

Such are the ordinary phenomena observed in the early stages of a lacerated lung. The effects subsequently produced consist in a localized traumatic pleuro pneumonia associated with slight elevation of the temperature, possibly rusty sputum, and often severe dyspnoea. In the worst cases death may result from asphyxia.

Penetrating Wounds of the Chest, due to direct injury and often associated with fracture of the ribs, are followed by very similar effects. The story is modified, however, by the fact that the external wound in the chest wall allows of the exit of blood, arising either from an intercostal artery, the internal mammary, or from the wounded lung, and this combined with shock may prove fatal. The recognition of the source of the bleeding is not always easy, but it is probably of parietal origin (a) if it is unaccompanied by hæmoptysis, (b) if it increases obviously at each systole, and (c) if it can be controlled by digital compression. The treatment of bleeding from the intercostal and internal mammary vessels has already been indicated.

Moreover the open wound is often associated with the entrance of bacteria into the pleural cavity, as also of infected foreign bodies and portions of the clothing, and this may change the resulting pleuro pneumonia from a simple to an infective inflammation. Empyema is consequently a frequent sequela, whilst the inflammation of the lung may terminate in suppuration or gangrene, though this is uncommon. Surgical emphysema is also induced by air being sucked into the cavity during inspiration, and failing to escape during expiration, owing to the lips of the wound falling together, it may ensue even when the lung itself has not been damaged. When a large wound is present, the lung flaps up and down in the opened pleural cavity, and this is undoubtedly an important element in the production of the great shock induced by these injuries. When the lower part of the chest is injured, there is always the likelihood that the pericardium, or even the heart itself, may be involved, especially in gunshot wounds, the diaphragm also is frequently torn or perforated, and the abdominal viscera may be implicated. A torn diaphragm admits of the hernial protrusion of the abdominal contents, and strangulation may follow.

Treatment—When the injury is non-penetrating, the patient should be kept quiet in a warm room, and the side strapped. This compression of the chest wall must be generally omitted in patients where the irregular ends of fractured ribs, broken by direct violence, are driven inwards, for fear of increasing the mischief in the lung.

Persistent hæmoptysis should be treated by keeping the patient absolutely quiet in the horizontal position and applying cold to the side. Morphia is especially needed when great restlessness and irritability are present. Lactate of calcium may also be given by the rectum. Stimulants are necessarily contra-indicated for fear of increasing or restarting the hæmorrhage. The effect of such expectant

treatment will be to cause the blood in the pleural cavity to clot and thus acts as a tampon to the affected viscus. In bad cases under such conditions bleeding may only cease when the patient is in a condition of profound collapse. blood transfusion or intravenous saline solution may then suffice to tide over the period of danger and lead to a successful result.

The treatment of hemothorax is governed by the recognition of the fact that the blood when effused in the pleural cavity does not as a rule clot *in loco* but that the fibrin is deposited as a layer over the parietal and visceral pleura as a result of the churning movements of respiration. Organization of this fibrinous layer commences early and the lung is soon bound down by it so that even though the fluid is absorbed or removed at a later date the lung does not fully re-expand and defective respiratory movements ensue. A small hemothorax, i.e. one about a hand breadth in depth may usually be left to the natural powers of absorption if it does not quickly decrease however aspiration may be employed. A large hemothorax with fluid blood present should always be aspirated early and if need be the aspiration must be repeated more than once and the removed fluid replaced by air. The exudate should be examined bacteriologically and when pus is present open operation with a view to emptying the cavity completely should be undertaken. The presence of a large hemothorax with clotted blood which cannot be withdrawn through an aspirator is also an indication for opening the chest.

In the early cases the scope of a thoracotomy should not be limited merely to the introduction of a drainage-tube but should consist in removing four inches of a rib suitably situated so as to permit the introduction of a retractor or rib-spreader. A bleeding intercostal artery can then be secured the whole of the clot cleared out and injuries to the lung dealt with. The operation and its after treatment are similar to those for a penetrating wound (*vide infra*).

Simple pneumothorax seldom requires surgical treatment since the imprisoned air is quickly absorbed and the lung re-expands should this not occur and if severe dyspnoea is present it may be advisable to remove the air by aspiration. This may sometimes fail or the air may re-collect and then the chest wall must be opened so as to permit of its escape. It is impossible for the lung to re-expand against the pressure of air confined in the chest when an opening is made the air can be driven out by a vigorous expiratory movement such as coughing which also forces air from the healthy lung into the wounded one when the glottis is closed.

Temporary dyspnoea may be overcome by the inhalation of oxygen but when of a more decided character and not due to any condition which can be removed it is essential to diminish the blood pressure and thus decrease the amount of blood carried to the uninjured lung so as to enable it to cope with the work of blood aeration. In urgent cases where the patient is becoming cyanosed, and life is threatened by asphyxia venesection must be adopted. The blood is withdrawn from the arm rapidly and freely and as it flows the dyspnoea ceases. This may be repeated once or twice before the full effect is obtained and respiration becomes unembarrassed.

The treatment of **Penetrating Wounds of the Thorax** involving the lung is always a matter of considerable difficulty. When the wound is of large size air is sucked in and out of the chest freely and the lung collapses immediately followed by mediastinal flapping causing respiratory distress and shock. First aid treatment consists in rapidly cleansing the wound and surrounding skin and then in closing the chest if possible by sutures through the soft parts or by effective packing. As soon as this is accomplished the respiratory distress diminishes and the blood collecting in the pleural cavity exercises pressure and helps to check further loss. In gunshot wounds radiographic examination is important to determine the presence or not of metallic fragments or of detached spicules of broken ribs. Screening is often more effective than photography owing to the rapid movements of the chest.

If further operation is required local infiltration analgesia will often suffice or gas and oxygen may be administered. The condition of shock which is often extreme should be treated by warmth and blood transfusion. The ragged margins of the wounds are carefully excised and fragments of broken ribs removed. The thorax is freely opened and clots are turned out foreign bodies removed (care being taken to explore between the diaphragm and chest wall posteriorly where heavy bodies may gravitate) and the lung itself is drawn up and examined. Torn fragments may be removed the base being ligatured or sutured. A superficial penetration may be made good by suturing with or without excision. A deep penetration is cleansed by strips of gauze but in all cases it is essential that the lung should be completely closed if practicable. The lung is so vascular that as a rule it can take care of itself as regards infection. Surrounding parts *e.g.* the pericardium and diaphragm are then gently explored and wounds are suitably treated. Finally the chest wall is completely closed a muscular flap being turned in to make good irreparable gaps in the pleura. No drainage is provided. The air in the pleural cavity is removed by aspiration or replaced by oxygen and a recurrent effusion is similarly treated. If infection occurs drainage can always be established at a later date.

Of course it may not always be possible for a surgeon single handed to undertake such extensive proceedings but at least an effort must be made to excise the wound margins and to remove fragments of broken rib and damaged muscle. The opening in the chest wall ought to be closed effectively in all cases and hæmothorax or infection is treated at a later date by aspiration or open drainage.

Hernia of the Lung or pneumocele is a rare condition in which a portion of the lung protrudes through an opening in the thoracic parietes beneath the uninjured skin. It may occur suddenly as the immediate consequence of a laceration of the intercostal muscles and pleura or more gradually being then due to the yielding of a cicatrix. It is most usually seen about the fifth intercostal space but has been known to develop in the root of the neck from a lesion in the dome of the pleura. It appears as a rounded swelling increasing in size on coughing or making expiratory efforts and possibly disappearing

entirely on holding the breath. It imparts a crepitant feeling to the fingers when compressed and on auscultation a loud vesicular murmur is heard. As a rule no treatment is necessary beyond the application of a pad or truss but if it causes much trouble the part should be exposed by a suitable incision the lung freed from its adhesions and replaced in the chest cavity and the defect in the wall made good by implanting a flap of fascia lata covered by a pedunculated flap of muscle from the neighbourhood.

A similar condition arising as a complication of an open wound is termed a prolapse of the lung. An attempt should always be made to return the protruded viscus and to prevent its recurrence by suturing the aperture through which it has escaped. If left unreduced it is very likely to become gangrenous from strangulation and should then be removed by the application of a ligature the wound being subsequently closed.

Abscess of the Lung is a commoner condition than is usually recognized. It may arise from the aspiration of foreign material such as septic blood clots after the removal of tonsils or teeth from erosion round a foreign body impacted in a bronchus and from an unresolved patch of pneumonia either of the broncho-pneumonic or of the lobar type. It may occur from a septic infarct and in cases of septicæmia and pyæmia these may be multiple. It is usually unrecognized in the early stages the patient often being treated for a purulent bronchitis. As the condition advances the sputum becomes more copious and frequently offensive the amount coughed up in twenty four hours cannot be taken as an indication of the size of the lesion. With the increased sputum the patient begins to waste rapidly and develops a secondary anæmia and sweats. The pulse is rapid and the temperature swinging. An examination of the lung usually reveals an area of dulness with diminished or absent breath sounds and there may be signs of cavitation. In the more chronic cases clubbing of the fingers is seen. An examination of the sputum may show lung tissue or elastic tissue this indicates that the abscess is communicating with a bronchus and that partial drainage is taking place. The X ray picture varies considerably it may show a dense shadow with an irregular diffuse edge situated in the substance of the lung usually towards the periphery or the shadow may be less dense with a fluid level in the centre. This latter picture is quite characteristic and indicates that the abscess communicates with a bronchus and an attempt at evacuation is taking place. The introduction of lipiodol is not usually helpful as the cavity is either closed or the opening is set obliquely and does not allow the oil to run into it. Various views should be taken to localize as far as possible the position of the abscess and the exact site where it approaches nearest to the chest wall (Plate XVI Fig. 1).

The Treatment of pulmonary abscess depends on its size and age the former being gauged by the radiographic appearances and the latter by the history. There can be little doubt that a large number of cases are cured without surgical intervention and particularly so when small post-operative abscesses arise as septic infarcts or from aspira-

tion Such an abscess usually shows itself about fourteen days after operation in the manner above described and is diagnosed by a radiogram, and frequently shows a fluid level The patients should be kept in a sitting posture, whatever the position of the abscess, as this allows them to cough up the pus more efficiently and with greater ease The value of bronchoscopy in this condition is referred to at p 1029 In the more chronic cases, other steps will have to be taken Aspiration of the abscess through the chest wall, either for diagnosis or treatment, is to be condemned owing to the risk of setting up an empyema The production of a pneumothorax in order to collapse the lung around the abscess has been advocated, but in our opinion is only suitable for very early cases without much surrounding consolidation, as there is a risk of collapsing the healthy lung round the diseased area, and preventing what drainage may be available through the bronchial tubes The best method is drainage by an open operation The incision should be placed over the area where the abscess, as seen by X rays, approaches nearest to the chest wall A large portion of rib is excised and the pleura opened if adhesions are present between the visceral and parietal pleurae, these should be reinforced with a few stitches An exploring needle is passed into the lung until pus is found The lung is then incised, either with a knife or by a cautery passed along the needle, and the pus evacuated, necrosed lung and lymph should be removed gently with the finger, and the opening into the cavity enlarged to allow of adequate drainage At the same time an estimate should be formed of the wall of the abscess, this may be either soft and collapsible, or in old chronic cases, very hard and epithelialized, this latter type will usually require a further collapsing operation at a later date and may even require lobectomy A tube is introduced into the cavity and packed round with gauze If on opening the pleura no adhesions are found, palpation of the lung should be undertaken to estimate the size and position of the abscess, this is readily determined by the presence of an indurated mass in the substance of the lung In such a case the lung should be brought up to the parietal pleura and stitched to it or if this is not feasible, the wound should be packed with gauze in order to promote adhesions, and the abscess opened four to five days later It has been observed that in cases where there is a free pleural space packing to produce adhesions has sufficiently collapsed the abscess to bring about a cure of the condition without external drainage This method of packing has been advocated to be used extra pleurally to produce collapse, but its value is doubtful The drainage tube should be left in position until the discharge is no longer offensive and then gradually withdrawn If the abscess cavity does not close, some form of local collapsing operation will be subsequently required

The causation of Gangrene of the lung is similar to that of lung abscess The infection, however, is usually more virulent, and the patient's resistance less This results in a larger area of the lung being involved with no well marked limitation of the disease The portion of lung affected is airless, and on handling has the appearance of a large slough, no adhesions are found between this mass

and the parietal pleura—in fact the pleura may also become gangrenous

The progress of the disease varies considerably some cases dying within a few days others lasting for some months. The *Treatment* is surgical a wide exposure of the diseased area is made and the sloughs separated if necessary by ligature and the wound lightly packed with gauze soaked in some form of antiseptic. The prognosis is bad as these patients are exhausted by coughing and the severity of the septic process

Bronchiectasis is a condition characterized by dilatations of the bronchial tubes either single or multiple. The cavities are usually situated in the lower lobe and are frequently bilateral the left lower lobe is the commonest site if the disease is unilateral. It may be caused by the presence of a foreign body which partially blocks a bronchus and prevents the distal tubes from being properly emptied secondary infection causes softening of the tubes with consequent dilatation or a localized softening may take place round the foreign body giving rise to a single bronchiectatic abscess. Fibrosis following a pneumonia or other lung and pleural infections may distort the affected bronchi and produce dilatations which are increased in size by the weakening of the walls due to retained secretion and the condition can frequently be traced consequent to the exanthemata and pertussis. It is also said to occur following a collapse or atelectasis of a portion of the lung thus accounting for the frequency with which it is found in the left lower lobe. As the disease advances there is marked fibrosis of the lung round the affected areas with distortion of the mediastinum

Symptoms and Signs—These are by no means typical. The patient may only complain of recurrent attacks of bronchitis or fevers and chills from time to time with occasional sweating. The cough may be persistent and hacking and of such an intractable character as to be unrelieved by heroin and other remedies. The sputum varies in amount and in its character in its mildest form it may be slight in amount and of frothy type while in advanced cases it may amount to over a pint a day of the very foulest expectoration. In milder cases the patient expectorates a large quantity of sputum in the morning and for the rest of the day is relatively free from cough. Owing to the inflamed condition of the affected tubes hæmoptysis from granulation tissue is common

The signs of bronchiectasis are varied the presence of basal collapse and cavitation with alteration in the breath sounds are suspicious in cases with a clear history especially if these signs alter with postural treatment the certainty of the diagnosis is usually completed by the presence of clubbing of the fingers and other signs of hypertrophic pulmonary osteoarthropathy. The diagnosis is confirmed by the introduction of iodol into the bronchial tree either by injection through the crico-thyroid membrane or by nasal catheter the degree of dilatation and its extent can thus be estimated

The *Treatment* of the condition is in the first place medical but surgery holds out the only hope of cure in selected cases. Bronchos-

copy should always be undertaken as it may permit the removal of a foreign body or by treatment of granulation tissue allow improved drainage and so prevent the extension of the disease

In cases where the disease is unilateral and confined to one lobe lobectomy should be considered (Fig 638) This is most successful



FIG 638 —BRONCHIECTASIS (LOBECTOMY SPECIMEN)

in children and young adults and should not be performed in elderly patients In this country the operation performed is one stage lobectomy this is most successful and has a mortality of about 20 per cent a figure which is high but will improve with increasing familiarity with the post-operative complications Other surgical procedures are lobectomy in two stages the first stage being an attempt to cause adhesions between the upper lobe and the parietal pleura so that the

diseased lobe is removed from a closed pleura, in contradistinction to an open pleural space as in the one-stage lobectomy. The disadvantage of this method is that the lobes, or lobe, left behind cannot so freely expand to fill that side of the chest owing to their preformed adhesions.

A third method of dealing with the diseased lobe is by cauterization, pneumectomy, in which the lobe is removed piecemeal by several cauterization excisions—an operation that has little to recommend it.

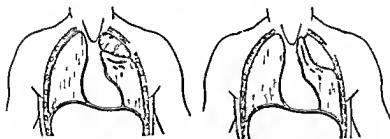
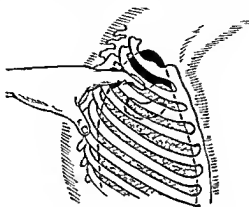


FIG 639—DIAGRAMMATIC ILLUSTRATIONS OF WAX PLOMBAGE

The small portion of the third rib posteriorly that has been removed is obscured by the finger. The relaxation of the lung produced is shown in the second and third diagrams.

Massive plombage in those cases which are not fit for lobectomy has been done, and seems to hold out a reasonable hope for such cases (Fig 639).

Lobectomy—In the one-stage operation great care should be taken in the preliminary treatment. The patient should be given postural treatment in a Nelson bed for a period which varies with the amount of sputum, and at the same time a vaccine should be given. Particular care should be given to the diet and the patient should be



FIG 1—BRONCHIECTASIS IN A CHILD

The dilated cavities can be seen filled with lipiodol while the normal bronchial tree can be seen on the right side. Some lipiodol can be seen in the stomach and the gas bubble in the stomach allows a clearer picture of that portion of the lower lobe which dips down behind the diaphragm



FIG 2—BRONCHIECTASIS IN A YOUNG ADULT

This is the unilateral type. The dilated tubes are seen filled with lipiodol and extend throughout the left lung. The mediastinum is pulled over by the fibrosis as is seen by the deviation of the trachea. The blind area of the lung obscured by the diaphragm is well seen in this case as in Fig 1

encouraged to take a full diet rich in proteins, as their protein loss in the sputum they produce is very considerable

Several days before operation an artificial pneumothorax should be produced. The quantity of air introduced need not be large, and it is a disadvantage to keep it up too long, as this is liable to delay re-expansion of the lobe, or lobes, left behind

At the operation the patient is placed on the non-affected side, and

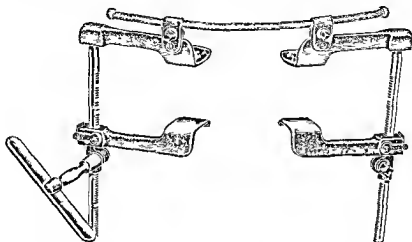


FIG 640—TUDOR EDWARDS'S DOUBLE RIB SPREADER

a pillow or sandbag placed under the ribs in order to open up the intercostal spaces. The anæsthetic should be avertin and gas and oxygen, or cyclopropane, and an increasing number of cases are being done under spinal. An incision is made in the seventh interspace from the nipple line in front to the erector spinæ behind. The incision

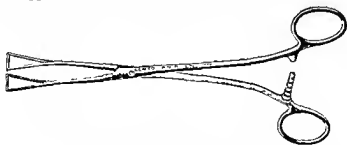


FIG 641—DUVAL'S LUNG FORCEPS

is deepened to the intercostal muscles and then through these to the pleura, which is opened. This opening is carried throughout the length of the wound, keeping close to the upper border of the rib. A small portion of rib behind the angle is then removed and the intercostal bundle divided and ligatured. The rib spreaders (Fig. 640)

are introduced and opened. The affected lobe is seized with lung holding forceps (Fig. 641) and all adhesions divided with scissors. The pulmonary ligament is also secured and divided up to the hilum. A tourniquet (Fig. 642) is then placed round the separated lobe as close to the mediastinum as possible (Fig. 643). The pleural space is packed off with flanne gauze and the lobe removed. The stump is then sutured with mattress catgut sutures and the bronchi touched with carbolic or flanne (Fig. 644). The tourniquet is released and the stump allowed to fall back. When complete hæmorrhage has been secured the spreaders are removed and the ribs approximated with sutures with the help of a rib approximator (Fig. 645). The wound is then sutured. A large trocar and cannula are introduced into the eighth interspace and a suitable self retaining catheter left *in situ*. The large pneumothorax is decreased in size either through this catheter or with a syringe and needle. The complications of the operation are

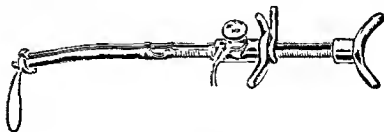


FIG. 642.—TUDOR EDWARDS'S LUNG TOURNIQUET

those of sepsis and atelectasis of the remaining lobes. The catheter which is left in the space is connected with a closed drainage system which helps to expand the remaining lobe and also drain the cavity. This in the majority of cases is sufficient but in some cases a rib resection has to be performed about the tenth day to drain an empyema. Pericarditis and cerebral abscess may lead to a fatal termination.

In certain cases where bronchiectasis is unilateral but more than one lobe is affected total pneumectomy may be advised. This is naturally a very much more serious procedure but is justified when the ultimate conclusion of the disease is taken into consideration.

Lipiodol injections as has been already stated help very considerably in the diagnosis of surgical affections of the lungs. One method is by the crico-thyroid route: the patient lies on the back with the head extended. A small area of skin over the crico-thyroid membrane is injected with novocain after purification. The needle of a syringe is then inserted into the trachea and about 5 to 10 minims of 10 per cent cocaine injected. The patient is instructed to cough which sprays the trachea and under surface of the glottis and produces sufficient anaesthesia for the injection of the oil. A small trocar and cannula or a wide-bored needle is then inserted through the crico-thyroid membrane and about 20 c.c. of warmed lipiodol slowly injected. The patient

being turned to the affected side while the oil is running in. If a picture of the upper lobe is desired the operating table is fixed in a moderate Trendelenburg position for a few minutes after the oil has been injected this allows the oil to run into the upper bronchial tree on the affected side. Another is by the introduction of a catheter through the nose after cocaineization the catheter striking the posterior pharyngeal wall is automatically directed forward and passes through the glottis.

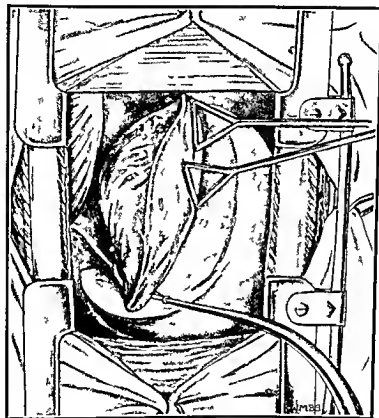


FIG 643 —LOBECTOMY THE LOWER LOBE WITH THE TOURNIQUET IN PLACE

Pulmonary Tuberculosis in its chronic form is a disease that can be dealt with by surgical measures. Like tuberculosis elsewhere in the body rest to the diseased tissues is the chief means of curing the disease and in the lung this is best attained by collapsing the affected organ. This can only be employed however in the absence of disease in the other lung or with the other lung only slightly involved. The ideal method of collapse is by means of an artificial pneumothorax which is produced and maintained by the introduction of air into the pleural

cavity and in some cases of oil (oleothorax) the details of the technique are to be found in the special literature of the subject. Complete collapse of a lung may fail owing to the presence of adhesions between the visceral and parietal pleuræ: these adhesions may be local or general. If local they can be divided intrapleurally, this is undertaken by means of a thoracoscope (Fig 646) an instrument like a cystoscope which is introduced through a cannula into the pneumo

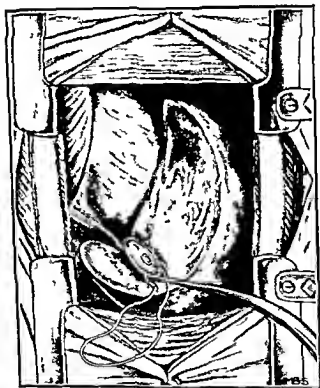


FIG 644.—LOBECTOMY THE LOBE REMOVED SHOWING SUTURES BEING PLACED IN THE STUMP

thorax cavity under local anaesthesia and the adhesions examined and divided by a cautery through a separate cannula or attached to the main instrument. The division of these adhesions should not be done by diathermy as there is considerable risk of later cloughing extending into the pulmonary end of the adhesions with subsequent infection of the free pleural space for the same reason the adhesions should be divided as close as possible to the parietal pleura to avoid injury to pulmonary tissues (Fig 647). After the division of the ad

hesions, the artificial pneumothorax is completed at a later date. If the adhesions are general or cannot be divided, other steps to collapse the lung have to be undertaken.

Local collapsing operations are beneficial in a certain number of cases. This chiefly applies to **phrenic avulsion**, which paralyzes the diaphragm, and allows collapse to take place at the base of the lung as the diaphragm rises in the chest, and also permits shrinking of the lung from the fibrosis which is part of the disease. The phrenic nerve is exposed in the neck under local anæsthesia. A small transverse incision is made in the skin and platysma muscle over the lower end of the sterno mastoid. The external fibres of the muscle are split, the posterior sheath incised, and by blunt dissection the scalenus anticus muscle exposed. The phrenic nerve is identified running in the sheath in a longitudinal direction, it is anæsthetized with novocain, separated and divided, a small length of the nerve is pulled up and about three inches removed. In certain cases a temporary phrenic paralysis is desirable, and in such cases after exposing the nerve, it is crushed with Spencer Wells forceps, when this is done a search must be made

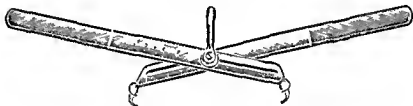


FIG. 645.—ROBERT'S RIB APPROXIMATOR

at the outer border of the scalenus muscle for an accessory phrenic, and if one is present it should be divided.

Paralysis of the diaphragm as a routine procedure should not be performed. It is of considerable value in cases of hæmoptysis, severe unilateral fibroid phthisis and in certain cases of infiltration without cavitation. It should not be undertaken as a single procedure in apical cavitation.

Where cavitation is present every endeavour must be made to allow the cavities to close. Although this closure may occasionally occur spontaneously, it is so rare that surgical intervention is nearly always required. The procedures adopted are either the removal of portions of the ribs, or the relaxation of the lung by stripping the parietal pleura from the chest wall, and preventing re-expansion by the introduction of muscle, fat, or paraffin wax (plombage) (Fig. 639). This procedure is not free from complications. The wax may be extruded, it may ulcerate through into the cavity and be coughed up, or it may travel down and lie above the diaphragm. It is therefore better to use this method in cases in which rib collapsing operations have not completely closed the cavity, or where the patient's age contra indicates partial thoracoplasty.

Where cavitation is present there is little doubt that some form of

rib resection should be undertaken. This consists of the removal of portions of the ribs posteriorly paravertebral thoracoplasty. The

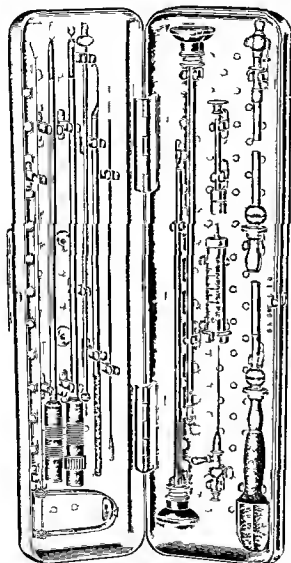


FIG. 46.—THORACOSCOPE IN CONTAINING STERILIZER.
The whole unit can be boiled.

operation in its fullest extent consists in the removal of portions of the first and the tenth ribs posteriorly from the tips of the transverse

processes laterally an amount varying from 2 to 7 inches being removed and the whole operation being extra pleural (Fig 648)

Variations of this extensive operation are used depending on the individual requirements in some cases removal of portions of the upper three ribs is sufficient in others eight, and in some a complete procedure (Fig 649) It may be said that where a partial thoracoplasty is done the amount of rib removal is larger than in the complete operation Some surgeons advocate the removal of the transverse processes as well and others when a local apical thoracoplasty is performed also strip the apical parietal pleura to produce increased collapse by mobilizing the apex and mediastinal pleura These operations are performed usually in stages depending on the patient's condition and the degree of collapse required Post operative



FIG 647 — ADHESIONS AS SEEN THROUGH A THORACOSCOPE

The ribs and intercostal muscles shining through the parietal pleura can be identified with two adhesions one fibrous and one fleshy

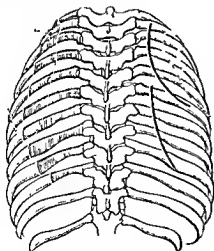


FIG 648 — DIAGRAM TO ILLUSTRATE THE INCISIONS IN TWO STAGE THORACOPLASTY

The shaded portions of the ribs represent parts removed

complications are relatively few and the degree of shock is not so severe as might be expected with such an extensive operation

The collapse obtained is very striking especially at the apex and is increased by weights being applied the degree of deformity is scarcely noticeable with the patient clothed as the shoulder is maintained by the clavicle (Fig 650)

New Growths of the Lung are either primary or secondary The former are carcinomas and most commonly arise from the hilum and spread into

the lung they may however rise at the periphery. This latter type can occasionally be dealt with surgically, the affected lobe being removed. In certain cases it may be possible to do a pneumectomy with individual ligation of the vessels and bronchus, and subsequent X-ray treatment of the posterior mediastinum. These tumours are squamous-celled and frequently of a basal-celled type.



FIG 649—PRICE THOMAS'S RIB SHEARS

arising in the pulmonary alveoli of epithelium of the smaller bronchi (Plate XVII Fig 2)

Secondary carcinomas are multiple and of course do not lend themselves to surgical interference.

Hydatid Cysts of the lung are occasionally seen in this country, but are common in Australia. They may attain a large size and may be full of daughter cysts or contain only fluid. They may rupture into a bronchus with a natural cure or they may suppurate, being then indistinguishable from an abscess. The symptoms are a slight cough, night sweats and hæmoptysis; if close to the surface there may be local pain and friction. An area of dulness is present on examination.

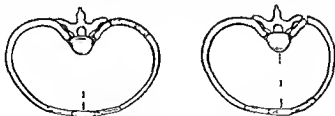


FIG 650—DIAGRAMS TO ILLUSTRATE THE COLLAPSE THAT OCCURS AFTER THORACOPLASTY

with diminished breath sound. The diagnosis is made by radiography, the cyst showing with a clear outline unlike an abscess. When not suppurating, the endo-cyst is readily removed after thoracotomy, the cavity being drained for a few days.

Bronchoscopy in Lung Diseases

Not only is the bronchoscope used for the removal of foreign bodies from the air passages, but use is made of it also for the diagnosis and treatment of various neoplastic and inflammatory diseases.



FIG 1.—A LATERAL VIEW OF A CHEST WITH AN ABSCESS CAVITY IN THE UPPER LOBE
The diffuse shadow of the abscessus shown a well marked fluid level can be seen in the centre with an air space above indicating that the abscess communicates with a bronchus and that partial drainage is taking place



FIG 2.—A CARCINOMA OF THE LUNG IS SEEN ON THE RIGHT SIDE
The shadow is dense & fissure at the edges and continuous with the hilum A partial pneumothorax has been produced for diagnostic purposes and the edge of the lung can be seen some distance from the chest wall The tumour which is situated in the lower part of the upper lobe has fallen to a lower level on collapse of the lung

Non-malignant New Growths in numerous instances have been removed through a bronchoscope. In our own experience, a patient with recurrent hæmoptysis lasting for several months and suspected as being of tuberculous origin, was found after the injection of lipiodol, to have a filling defect at the commencement of the left lower lobe bronchus. Bronchoscopic examination showed the presence of a smooth neoplasm from which a piece was taken for microscopic examination, the section showed a fibroma, which was nibbled away on a subsequent occasion with apparent cure.

Malignant New Growths.—As the majority of the carcinomata in the lung either commence in a bronchus or invade the lumen at an early date, examination with a bronchoscope will in all probability establish a diagnosis. The friable and free bleeding growth can be seen and a piece taken for microscopic examination, clearance of the lumen of the affected bronchus will allow air to enter the lung and relieve the patient to some extent of the distress associated with suppuration in the obstructed area. An intubation tube containing radon seeds, as designed by Tudor Edwards, may be inserted into the affected bronchus and left in position for seven days, sometimes with a good result.

In one case dealt with, a small pedunculated alveolar carcinoma was removed complete from the right main bronchus, with disappearance of symptoms for several years and with free air entry into a previously airless lung.

Lung Abscesses, if treated within a few weeks of inception, respond well to bronchoscopic treatment. The abscess results in the majority of cases from inspiration of infected clot during or soon after operations in the mouth or pharynx particularly after extraction of teeth or removal of tonsils. Infective material carried down causes partial or complete blockage of a bronchus with suppuration in the lumen of the tube. Removal of the plug cures the condition in most cases, it is attained by aspiration with a Chevalier Jackson's bronchoscope fitted with a suction tube, and by swabbing the inflamed walls of the bronchus and any granulation tissue with 10 per cent. silver nitrate.

In many cases an abscess forms outside the bronchial wall in the parenchyma of the lung, owing to spread of infection through the bronchial epithelium, or as a result of blood borne infection. If this abscess bursts into the bronchus—as usually occurs—aspiration will afford a good chance of recovery, as not only is the pus removed but free drainage is established by dilatation of the inflamed and partially obstructed bronchus, together with reduction of swelling by local applications of silver nitrate.

Bronchiectatic Abscess—If an abscess in the parenchyma of the lung drains for a considerable time into a bronchus or if a local inflammatory condition commences in the bronchus itself either because of the presence of a clot or of a foreign body of a solid nature, the bronchial walls become inflamed and weakened and are finally distended. A cavity of large size may be produced and it is then difficult to say how much is made up of the original lung abscess and how much is true dilatation of the bronchus. Whatever be the formation of the walls, bronchoscopic treatment should be tried, and may give good

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results if a foreign body is found and removed the condition will in all probability be cured. In one case the removal of a complete vertebra of a rabbit which had been in the right lower lobe bronchus for sixteen months and had produced a bronchiectatic abscess from which copious pus was coughed up daily cured the patient.

Many other cases of this type—that is to say those in which a single cavity is present usually in one or other lower lobe—have responded well to bronchoscopic treatment carried out under local anaesthesia with little discomfort to the patient who is not necessarily confined to bed. If the treatment fails some form of external operation may be necessary. bronchoscopy should however be performed first as it is frequently efficacious and is always harmless if performed with local anaesthesia.

Multiple Bronchiectasis—Numerous small dilatations on the finer air tubes secreting pus are not so favourable as single cavities but it is possible even then to improve the general condition of the patient and to add to his comfort by the removal of stagnant secretions and the reduction of obstructive swelling of the larger bronchi which prevents the expulsion of sputum when the patient attempts to empty his lungs by coughing. If the general and local conditions do not improve after a few treatments by bronchoscopy some more radical procedure will be called for such as division of the phrenic nerve or thoracoplasty.

Surgical Diseases of the Heart and Pericardium

Wounds of the Heart are of two classes the non penetrating and the penetrating. The former are due to injuries of a crushing nature and as the heart is injured by the fragments of overlying bones it is unusual for surgical treatment to be practicable in such cases the latter are the commoner form of injury and in certain instances the wound in the heart can be sutured or foreign bodies removed. The right ventricle is most frequently injured the left auricle least frequently. Owing to the thin wall of the auricles injury to them is more dangerous than to the ventricles the thick muscular wall of the latter may suffice to check the hæmorrhage. The patient may die from the immediate cessation of the heart's action or from intrapericardial pressure of blood or from internal or external hæmorrhage.

If the patient does not die at once he suffers from intense shock and prostration combined with a weak and turbulent action of the heart great pain in the chest and dyspnoea whilst the pulse is scarcely perceptible. The area of cardiac dulness may be greatly increased. In over 70 per cent of cases the pleura will also be wounded so that blood escaping externally will be frothy. Purulent pericarditis is likely to ensue.

Treatment—The patient must be kept absolutely quiet and with the head low until it is decided whether or not operative interference is justifiable. If the case is to be left the external wound is purified and no attempt made to explore it with the finger or probe for fear of dislodging clots. If operation is attempted an anaesthetic is given a trap-door incision consisting of the fourth and fifth costal cartilages

is turned up, the pericardium freely incised this allows blood-clot to escape, and with the decompression of the heart its action becomes stronger, the wound in the heart is gently explored and closed with deep sutures inserted through the muscular substance. A certain number of cases are on record where a wound of the heart has healed spontaneously even with a bullet in its substance, and the patient survived for years.

Cardiac Massage has been performed with success in cases where the patient has had a syncopal attack during the administration of an anæsthetic. An opening is made into the peritoneal cavity, a hand introduced, and the heart massaged through the diaphragm.

Pericardial Effusion, whether serous or purulent, may require surgical treatment in order to relieve symptoms of cardiac failure, due to the pressure of the exudate. The sac, when distended, pushes aside the pleuræ and lungs, and also is enlarged upwards, carrying up the base of the heart and rotating the apex forwards to a slight degree. The bare interpleural area of the pericardium is therefore increased and the cavity may be tapped by trocar and cannula or by aspirator, either close to the left border of the sternum in the fifth interspace, or one and a half inches from the sternal edge of that bone, so as to avoid the internal mammary trunk which courses down about half an inch from the border.

For suppurative pericarditis incision and drainage are necessary. This may be readily accomplished by removing the fifth costal cartilage and dividing the underlying perichondrium and triangularis sterni, together with section between ligature of the internal mammary vessels. This exposes the pericardium, which is opened and washed out, and a drainage tube inserted. The prognosis is not good, as the patient's condition is bad.

Cardiolysis is an operation for the removal of a portion of the chest wall, lying in front of the heart with the object of replacing the comparatively unyielding thoracic wall by a soft, pliable covering. It has been performed in cases of valvular disease with great hypertrophy, and also for cases of adherent mediastino pericarditis to relieve the fixation of the heart to the chest wall, with its consequent mechanical disadvantage.

The parts usually removed have been the third, fourth, and fifth left costal cartilages, with or without a piece of the sternum and the ends of the corresponding ribs. It is desirable to remove the perichondrium, but in cases of adhesive inflammation this may be almost impossible without wounding the underlying structures. In cases of Pick's disease, where there are dense pericardial adhesions obstructing the large venous channels, the parietal pericardium which is usually calcified should be gently stripped off the heart and removed piecemeal, the most extensive removal being on the diaphragmatic surface in order to free the inferior vena cava, though the benefit from this operation is probably produced by decompression of the ventricles thus allowing better filling and prevention of back pressure effects in the auricles and large veins. Attempts have been made recently to deal surgically with anginal conditions. The relief of pain is attempted

by interference with the sympathetic thyroid circle, either by sympathectomy or by total removal of the thyroid gland. A more radical procedure is by supplying the sclerosed heart with a fresh blood-supply. This is done by grafting a portion of the pectoralis major on to the heart or by drawing up an omental graft through the diaphragm and fixing this to the ventricle.

Operations on the Great Bloodvessels have been performed. Trendelenburg's operation is an attempt to remove an embolus from the pulmonary artery. The suitable cases are few owing to the fact that death is in most cases instantaneous and because the plugging of the vessel is frequently thrombotic rather than embolic. One or other main branches of the pulmonary artery has been ligatured in a few cases to check severe hæmoptysis and in bronchiectasis, owing to the blood supply of the lung being derived from the bronchial arteries gangrene does not follow this procedure.

The affections of the mediastinum are most commonly infective (mediastinitis) and are seen in cases of cellulitis of the neck which spreads under the deep fascia. It may also follow operations on the neck when the pharynx or larynx has been opened. The commonest cause is from lesions in the œsophagus either ulceration from growths or following the impaction of foreign bodies. Abscess formation is rare the condition nearly always being fatal before a sufficient local resistance is set up. The patients complain of pain under the sternum and in the back with high fever and rigors there is dyspnoea and irregularity of the heart's action. Treatment is usually of no avail, but if the disease appears to be confined to the anterior mediastinum drainage may be effected by splitting the sternum. A chronic tubercular abscess may be located in the mediastinum, secondary to spinal caries. This calls for no operative interference unless paraplegic signs are present when a costo-transversectomy may be performed.

Tumours of the mediastinum are not uncommon if we include true retro-sternal goitres. Other forms are due to enlargement of glands as in lymphadenoma sarcoma of the thymus teratomata and dermoid cysts these latter usually push outwards into one or other pleural cavity and are frequently mistaken for tumours of the lung, an attempt to remove them should always be made. These tumours and cysts are always in the upper part of the mediastinum.

Asphyxia or apnoea is the term applied to indicate the condition arising from interference with or stoppage of the respiratory act. If this has not proceeded to any great extent it is termed dyspnoea; when however the obstruction is so marked that the patient is obliged to maintain the upright sitting position the term orthopnoea is applied to it.

The Causes of asphyxia may be classified as follows

I Conditions arising from the presence of abnormal contents within the air passages e.g. foreign bodies blood-clot or pus from the bursting of an aneurism or abscess serum as in œdema of the lung, mucus or muco-pus as in suffocation. Death by drowning usually arises from a similar cause viz the replacement of air by water in the respiratory passages.

2 Causes arising in the walls of the air passages such as diminution of their lumen from inflammatory congestion as in oedema of the glottis cicatricial stenosis the presence of new growths or the displacement of parts as in cut throat or the falling back of the root of the tongue after partial excision

3 Extrinsic causes or those arising outside the air passages *e.g.* in the neck strangling hanging garroting etc the presence of tumours such as goitres or aneurisms a retropharyngeal abscess or tumour or displacement backwards of the sternal end of the clavicle Within the *thorax* obstruction to the respiration may be caused by the presence of tumours aneurisms or effusion into the pericardium or pleura

4 Nervous causes *e.g.* paralysis or spasm of the larynx and paralysis of the diaphragm either from peripheral lesions such as the pressure of aneurisms or tumours on the nerve trunks or from central causes such as a lesion in the upper part of the spinal cord or medulla

5 In many forms of cardiac disease the lungs may become engorged with stagnant blood leading gradually to dyspnoea orthopnoea and asphyxia owing to increasing difficulty in eliminating carbonic acid

The Treatment of asphyxia varies much under different circumstances A rapid examination is at once made to ascertain if possible the cause of the mischief and whether its onset has been gradual or sudden If it has been gradually developing it is not uncommonly due to some thoracic condition which cannot be immediately relieved if however its onset has been sudden and not the result of any evident lesion the neck and chest should be bared and examined for signs of traumatism the mouth opened the tongue drawn forwards and the glottis examined with the finger to see that the passages are clear The patient should if necessary be removed into fresh air and artificial respiration at once commenced Obstruction above or within the larynx needs tracheotomy or intubation as also conditions associated with pressure on the trachea

Artificial Respiration is required in a variety of surgical conditions and can be undertaken by what is known as Sylvester's method In this the patient lies on his back with a pillow beneath the shoulders the mouth opened and the tongue drawn forwards The arms are then grasped just above the elbows and drawn upwards above the patient's head so as to expand the chest through the action of the great pectoral muscles This position is maintained for about two seconds and then the arms are lowered to the side and pressed firmly against the ribs so as to determine a forcible respiratory act At the end of about two seconds more the arms are again elevated and the same cycle passed through This should be repeated about fifteen times a minute and the operator must be careful not to use too great violence or to hurry over it unnecessarily as harm rather than good results thereby

Another less satisfactory method consists in alternately compressing the lower part of the thorax and abdomen with the hands so as to drive out a certain amount of air and then by suddenly relieving the pressure the elastic expansion of the chest wall draws in a fresh supply

CHAPTER XXXVII

SURGERY OF THE NECK

In the second or third week of intra uterine life a series of branchial arches form in the human embryo as in other mammalia constituting the foundation from which the future structures of the neck are developed. In the majority of mammals five such post-oral arches occur separated from one another by the so-called branchial clefts, but in man the fourth and fifth are amalgamated. They project from the side of the primitive spinal column and consist of mesoblast lined on either side by epithelium. They unite across the median line at an early date and also one with another thereby leading to a large extent to the obliteration of the clefts. Occasionally, however, this union is imperfect and sundry malformations result.

It must be remembered that the mandible and the processus gracilis of the malleus arise from the first arch, the Eustachian tube, tympanic cavity, external auditory meatus and Glaserian fissure from a normally unobliterated portion of the first cleft, the styloid process, stylo-hyoid ligament and lesser cornu of the hyoid bone from the second arch, the body and great cornu of the hyoid bone from the third arch and the rest of the cervical tissues from the remaining arch whilst the second, third and fourth clefts are under ordinary circumstances totally obliterated.

Branchial Fistulae are due to imperfect closure of the branchial clefts. They consist of narrow sinuous tracks extending inwards from the skin and perhaps communicating with the pharynx but not necessarily so. The external opening is usually situated along the anterior border of the sterno-mastoid and most commonly near its lower end close to the episternal notch, the fistula then arising from the lowest cleft. They are lined with epithelium and secrete a glairy or mucous fluid. They are not uncommonly associated with other abnormalities such as macrostoma, absence of the pinnæ or accessory auricles situated either near the orifice of the fistula or close to the ear. In the majority of cases they may be disregarded, but if troublesome should be laid open and the lining membrane either dissected away or destroyed with the galvano-cautery.

Branchial Cysts arise from incomplete closure of a branchial cleft, the unobliterated portion becoming distended with secretion. They usually appear in adolescents, often between the ages of ten and twenty, and are frequently attributed to a blow which it may be presumed brings into activity structures which would otherwise have remained passive. They grow slowly and painlessly, forming rounded swellings, often rather soft, with more or less distinct fluctuation according to the depth at which they are situated, their contents if near the cutan

eous end of the cleft, are sebaceous in character, similar to, but more fluid than, that found in dermoid cysts, viz flattened epithelial cells, cholesterine plates and fatty granules. If placed nearer to the pharynx, they are occupied by a glairy mucoid fluid. They are usually lined with squamous epithelium, but a few cases have been recorded in which the cells were columnar and even ciliated in character. The most common situation is in the third cleft, the cyst then lying between the thyroid cartilage and the anterior border of the sterno-mastoid in relation with the great wing of the hyoid bone. When of large size, it may extend beneath that muscle, displacing it outwards. More rarely a cyst arises from the second cleft, being then located in the upper third of the neck, and spreading up towards the styloid process, it may even reach from the mastoid process to the hyoid bone running parallel to the inferior border of the jaw, and fluctuation may be detected through the mouth. *Treatment* consists in extirpation when the condition has attained sufficient size to be troublesome.

Branchial Carcinoma may similarly originate in some unobliterated fragment of branchial epithelium, and takes the form of squamous epithelioma, it may be primarily cystic or solid in either case running the ordinary course of the disease infecting lymphatic glands secondarily and destroying life by cachexia or hæmorrhage. It is usually seen in men of middle age, and may have been preceded by a small swelling which was probably noted earlier in life. The usual site is in the upper part of the neck (second visceral cleft), constituting a tumour deeply placed beneath the sterno-mastoid about the level of the hyoid bone, it is ill defined in outline and spreads rapidly forwards beneath the jaw in the submaxillary region. Neighbouring muscles are infiltrated, but involvement of the pharynx, œsophagus, or larynx is unusual. There is considerable pain from nerve involvement, spreading round to the back of the neck and head. The diagnosis can only be made by excluding all sources of primary infection elsewhere, and treatment is rarely practicable owing to the deep connections of the growth.

Various other congenital conditions may be met with in the neck. **Congenital induration of the sterno-mastoid** in all probability arises from injury during parturition, and usually occurs in head presentations, probably from bruising of the side of the neck against the under surface of the symphysis, it is said to be more common on the left side than on the right. In cases that have been examined microscopically, the indurated mass has been found to consist of fibrous tissue. It disappears spontaneously after a time, but may result in torticollis.

Congenital Cysts of the Neck—(a) *Dermoids* occur here as in any other region where congenital remains are found. As already mentioned, they may develop laterally from the branchial clefts, but may also be found in the middle line or in connection with the thyro-glossal duct. (b) The *thyro-glossal duct* (Fig 651) consists of a tubular outgrowth from the embryonic pharynx passing downwards behind the body of the hyoid bone in front of the larynx and trachea as far as the isthmus of the thyroid gland, which is subsequently developed from it, and unites with the lateral lobes which in turn spring from the deeper

parts of the branchial arches. The upper end of this duct is situated at the foramen cæcum of the tongue and thence traverses the substance of that organ between the gemo-hyo glossi muscles to reach the hyoid bone the lower end is represented by the pyramid of the thyroid isthmus. The whole of this tube disappears under ordinary circumstances if however the upper part remains unobliterated a dermoid cyst may originate from it placed either in the substance of the tongue or immediately below it. If the lower portion remains patent a cyst develops containing mucoid or glary fluid which however

is not present at birth. If it bursts spontaneously or is opened a so called *median cervical fistula* results. Accessory thyroid growths of an adenomatous nature may develop from any part of the duct but especially from the lower end they are quite innocent in nature and unless troublesome may be left alone. (c) *Cystic hygroma* is sometimes congenital but may also be acquired. It consists of a multilocular swelling the spaces composing it being due to dilatation of lymphatic spaces and filled with lymph. The tumour is often of considerable size with a sinuous irregular outline and may produce great deformity and marked pressure effects. The skin over it may be occupied by dilated capillaries or lymphatics. Unless extending to inaccessible parts such as the superior mediastinum it should be dealt with by excision.

Acquired Cysts of the Neck are of the following types (a) *Sebaceous cysts* develop in the skin as elsewhere but need no separate notice. (b) *Bursa cysts* are stated to occur in connection with the larynx and hyoid bone. There is usually a bursa over a prominent point

Adam's and this may become enlarged and distended with fluid. A the bursa is also stated to exist between the back of the hyoid bone and thyro hyoid ligament which might easily be mistaken for one of thyro-glossal origin. In doubtful cases a microscopical examination of the lining wall will quickly settle the diagnosis since if it is bursal in origin it is lined with endothelium whilst if it is thyro-glossal it is lined with epithelium. In the former case incision and drainage usually suffice to bring about a cure although excision is preferable in the



FIG 651. MEDIAN SECTION OF TONGUE LARYNX AND TRACHEA SHOWING THYRO-GLOSSAL DUCT EXTENDING FROM THE FORAMEN CÆCUM OF THE TONGUE DOWNWARDS BEHIND THE HYOID BONE AND IN FRONT OF THE TRACHEA TO THE ISTHMUS OF THE THYROID BODY (SEMI-DIAGRAMMATIC FROM COLLEGE OF SURGEONS MUSEUM)

A small dermoid cyst in the centre of the tongue is also represented

latter case the lining wall must be entirely removed (c) *Unilocular serous cysts* are sometimes met with in the lower part of the posterior triangle constituting the condition known as 'hydrocele of the neck' They contain serous fluid, with perhaps an admixture of blood Their origin has not been defined with any certainty, but they are probably due to a dilatation of the lymph spaces and are best treated by excision (d) *True hydatid cysts* also occur in this region (e) *Blood cysts* have been found in close connection with the large vessels of the neck They are possibly due to the dilatation of a vein and may communicate or not with some vascular channel, such as the jugular, being then partly emptied on pressure Where no communication with a venous trunk exists, the lining membrane is intensely vascular If their vascular origin is recognized, they should be left alone unless causing urgent symptoms If, however, a blood cyst is opened by mistake, the supplying vessels must be secured, if possible, and, failing that, the cavity must be packed with gauze soaked in adrenalin (f) Cysts are also occasionally met with in connection with the *salivary glands* and the *thyroid body* (g) *Malignant cysts* arise, as already mentioned, from the remains of the *branchial clefts* or from a degeneration of *epitheliomatous lymphatic glands* They are often of large size, and their removal is impracticable owing to the adhesions which they contract to the deeper structures

Cut Throat—Injuries of the neck are commonly met with in cases of attempted homicide or suicide, and vary much in severity according to the extent and position of the wound A right handed suicide usually cuts his throat from left to right, and therefore the incision is bold and clean on the left side, tailing off towards the right, in a left-handed suicide the incision runs in the opposite direction A homicidal cut throat varies in its direction according to whether it is done from behind or in front, and also with the hand employed If the front of the neck is mainly involved, the air passages are laid open, and the patient's life, though much endangered, is not necessarily destroyed If, however, the wound chiefly affects the side, the great vessels and nerves may be divided, and death from hæmorrhage is very liable to ensue The course and treatment of the latter class of case require no particular notice, since the general principles relating to all wounds must be adhered to Where, however, the air-passages have been opened, special complications arise, requiring suitably modified treatment.

Wounds involving the *Air-passages*, the result of cut throat, may be situated at four different levels (a) above the hyoid bone, encroaching on the base of the tongue (b) through the thyro hyoid space, the most common situation, (c) in the larynx, and (d) opening or dividing the trachea

The immediate effects of such lesions are due to shock, hæmorrhage, asphyxia, or the entrance of air into veins When above the *hyoid bone*, the root of the tongue and submaxillary region are involved, and hæmorrhage from the lingual or facial arteries or their branches follows, if the wound extends far enough, the main vessels are divided, and death results In the less severe cases the patient runs considerable

risk of being suffocated by the epiglottis and base of the tongue falling back over the larynx. Much difficulty will be subsequently experienced in feeding the patient owing to impairment of the movements of the tongue. When the *thyro-loid* space is opened the facial and lingual arteries are again in danger as also the upper part of the superior thyroid. The base of the epiglottis is divided and portions of mucous membrane around the entrance of the larynx may be detached and cause obstruction to respiration. Blood may also trickle down the larynx into the trachea and lead to asphyxia. Wounds of the larynx are usually transverse and not very extensive owing to the resistance offered to the knife by the cartilage. The thyroid body may be wounded and bleed freely otherwise there is but little hæmorrhage. Blood may find its way into the trachea or lungs and asphyxiate the patient. When the trachea is involved the common carotid and inferior thyroid vessels are very liable to be wounded giving rise to severe if not fatal hæmorrhage. Asphyxia may be brought about by displacement of the severed portions of the tube or from the entrance of blood into the air passages whilst air may also be sucked into opened veins. The recurrent laryngeal nerve may also be divided.

The secondary effects following cut throat are mainly inflammatory in origin. (a) The wound is likely to become infected giving rise to a cellulitis which may spread down to the mediastinum or to œdema of the glottis. Secondary hæmorrhage also arises from this cause and even general pyæmia. (b) *Inflammation of the air passages* tracheitis bronchitis or broncho-pneumonia frequently follows partly as a result of the entrance of cold air and partly from the admission of septic material such as food decomposing blood clot or discharges. The patient may become cyanosed from these causes and in consequence of the partial asphyxia the sensibility of the mucous membrane of the glottis is diminished allowing of the passage into it of food which appears at the mouth of the wound in some cases this may have arisen from division of the superior laryngeal nerve but the depth at which this structure is situated in the neck makes it difficult to conceive how it could be divided without injury to the main vessels. (c) *Surgical emphysema* or the entrance of atmospheric air into the cellular tissue may also follow a wound of the air passages. It is not limited to the neck but extends to the trunk being recognized by the puffy distension of the part and by a soft crackling crepitus elicited on pressure. It is of no great consequence and usually disappears in a few days.

The Treatment consists in securing all bleeding points if possible but occasionally they are placed so deeply that it is necessary to tie the external carotid general oozing from the surface must be attended to for fear of blood being sucked into the air passages. Every effort should be made to render the wound aseptic damaged portions of skin are excised as also hopelessly injured muscle if there is a reasonable prospect that asepsis has been attained the wound may be closed by sutures in the ordinary way. Where however asepsis is doubtful the wound should be packed with gauze soaked in flavine and suture deferred for a few days.

The treatment of the air passages varies with the site of the lesion. If the trachea has been roughly divided the portions should be steadied by a stitch on either side and a tracheotomy tube inserted—at any rate for a few days when cleanly cut total closure without the use of a tube can be safely permitted. When the wound involves the larynx it is desirable to close the opening at once since the larynx does not readily tolerate the presence of a tube; if necessary it is better to perform a high tracheotomy. When the wound involves the thyro-hyoid space or is situated above the hyoid bone it is quite safe in many cases to close the wound layer by layer after carefully disinfecting it. The mucous membrane is first dealt with by stitches which do not penetrate its whole thickness and then a more thorough purification can be undertaken if the epiglottis is divided it must be accurately sutured. If there is any doubt as to the advisability of this proceeding a high tracheotomy is first performed and then the wound closed as far as possible.

In every instance the head should be flexed on the chest and in suicidal cases a careful watch maintained to prevent the patient tearing the wound open. Loss of blood is dealt with by the infusion of saline solution or blood transfusion and the patient's general condition attended to. Feeding should always be undertaken through a nasal tube passed into the oesophagus whether that structure is wounded or not and this should be continued until the patient's natural powers of swallowing are restored.

The following Sequelæ occasionally result from a cut throat: (a) An *aerial fistula* is a persistent abnormal communication between the air passages and the external air and occurs most often in the thyro-hyoid space the skin and mucous membrane becoming continuous one with the other around the margins of the opening. In some cases it may be closed but if laryngeal stenosis or adhesions are present it must be left alone for a time until these conditions have been treated. The operation consists in separating the skin from the mucous membrane and in order to accomplish this the external wound must be enlarged vertically. The edges of the mucous membrane are then pared and stitched together horizontally. The external wound is either closed vertically or left partially open and packed. (b) *Laryngeal or tracheal stenosis* due to the cicatrization of wounds in these regions may necessitate the constant use of a tracheotomy tube. (c) *Aphonia* may arise from division of the recurrent laryngeal nerve and is then usually persistent. (d) *Oesophageal or pharyngeal fistulæ* may also in rare instances complicate the healing of an extensive wound in the throat, but tend to close of themselves and require no special treatment.

Diseases of the Thyroid Body

The thyroid body is a ductless secretory gland which lies beneath the fasciæ of the lower part of the front of the neck in close relation with the larynx and trachea. It consists of two lateral lobes joined by an isthmus which lies across the second third and fourth rings of the trachea, and from which a slight upward projection

is sometimes noted the pyramid which represents the original connection with the buccal cavity. The gland itself has a well defined fascial sheath and a fibrous capsule which dips in between the constituent acini to form the stroma between the two the vessels enter and many large veins are to be found. The blood supply of the gland is very free being derived from the four thyroid arteries which enter at the four corners and possibly from the thyroidea ima artery which runs up the front of the trachea to the lower border of the isthmus.

The glandular acini are lined with cuboidal epithelium and secrete a colloidal material which normally contains an albuminous preparation of iodine thyroxin. There is a very close connection between the acini and the surrounding lymphatics and venules. The secretory activity of the gland undoubtedly plays a very important part in the economy of the body but at present the whole subject of the internal secretions (hormones or endocrines) is not perfectly understood. A certain number of facts emerge clearly into the light of day but a fairly dense fog lies between them especially as regards the interaction between the varying secretions.

Accessory Thyroids sometimes develop above or below the isthmus. They may be connected with it moving up and down with it on deglutition or they may be independent occurring in any part of the thyroglossal duct and even in the base of the tongue in that situation resembling a dermoid cyst. If troublesome they should be removed and subjected to microscopic examination as their structure varies and there is a possibility of recurrence.

A classification may be given of the diseases of the thyroid body.

Inflammatory Diseases

Acute thyroiditis

Chronic thyroiditis (Riedel's disease woody thyroid)

Tuberculous thyroiditis

Non-inflammatory Diseases

Physiological goitre (adolescent goitre)

Colloid goitre (parenchymatous simple Derbyshire neck hyperinvolution goitre)

Nodular goitre (adenomatous goitre fibro-adenomatous goitre cysto-adenoma)

Toxic goitre primary (Graves disease)

Toxic goitre secondary (toxic adenoma)

Tumours

Simple—follicular adenoma

Malignant—carcinoma

Results of Thyroid Deficiency

Myxoedema—Cretinism

Acute Thyroiditis—The thyroid gland may be the seat of acute inflammatory disease by pyogenic organisms arising from local lesions such as cellulitis of the neck infection of a cyst or impaction of a

foreign body in the œsophagus, but more commonly it is a blood borne infection and may follow acute infective fevers. One lobe or the whole gland is involved and becomes enlarged, tender, and hot. Dyspnoea and dysphagia may be present, with general constitutional disturbance. If pus forms, rigors may occur, and should the infection spread outside the capsule, cellulitis of the neck may follow.

Treatment.—The patient is kept quiet in bed on a restricted diet, and his bowels and skin are made to act. Fomentations are applied to the part or an ice compress, and under such a regime resolution may occur. If signs of suppuration supervene, as frequently happens, free incisions must be made.

Chronic Thyroiditis (Riedel's disease, woody thyroid) also occurs, and is of a sclerosing type, the gland becoming hard, rough, and larger than usual, gripping the trachea tightly, and causing stridor. Although the substance of the gland may become almost replaced by fibrous tissue, there is no evidence of hyperthyroidism or hypothyroidism. The cells of the acini fuse together round drops of colloid, producing an appearance like a giant cell, so that a mistaken diagnosis of tuberculosis may be made. Division of the isthmus of the gland may be necessary to relieve the stridor, or hemithyroidectomy may be performed.

Tuberculous thyroiditis is occasionally seen, but syphilitic lesions are rare.

Goitre.—This term is applied to any non-inflammatory enlargement of the thyroid body, it does not indicate any special lesion, but a general or local physiological or pathological enlargement of the gland. Many theories as to the cause of goitre have been propounded, but none are fully satisfactory. At the present time workers in this field are striving to find a theory that will account for all types of goitre, the physiological, the colloid, the adenomatous and the toxic, and wish to regard their pathological and biochemical manifestations as gradations in one disease, rather than separate entities.

The thyroid gland being an important ductless gland, its function with reference to the general metabolism of the body must be considered, as well as the local manifestations. When the function of the gland is suppressed either by surgical removal or disease, a condition of hypothyroidism arises. In adults this results in *myxœdema*, which is characterized by a deposit of mucin in the subcutaneous tissues, the face becomes puffy, waxy white, and expressionless, with, perhaps, a hectic flush over the malar eminences, the tongue is enlarged, the limbs become thickened and clumsy by an increase in bulk of the soft tissues, a puffy mass often occupies the supraclavicular fossa, which, however, does not pit on pressure. The hair falls out, the pulse is slow, the temperature subnormal, and the mental faculties are dulled. Without treatment, death will result sooner or later from asthenia. In young children, absence, or destructive disease of the gland, produces *cretinism*. The children are of stunted growth, with pale, flabby faces, dirty habits, and with intellects so dulled as to be classified as idiots. In both these conditions the administration of thyroid extract (2 to 5 grain tablets once a day) produces great improvement.

been able to produce a goitre by feeding the filtrate of water from a goitrous district not only in animals but in healthy human subjects

while the filtrated water has produced no effect. Gaylord working with fish has produced evidence to support this theory.

Clinical Features—In all varieties of goitre the thyroid body is the site of a swelling involving its whole substance or one or other of its lobes or possibly the isthmus alone. Its consistence varies with the nature of the growth but it always moves with the larynx on swallowing. The local effects are produced from the anatomical position of the swelling. Pressure on surrounding structures leads to dyspnoea or dysphagia while the carotid sheath and its contents are displaced outwards accounting for the attacks of giddiness and fainting which sometimes occur. The trachea is especially liable to changes of



FIG. 623.—INFRA RED PHOTOGRAPH OF A LARGE RETROSTERNAL GOITRE IN A WOMAN AT 65.

The enlargement of the subcutaneous venous plexus is well seen.

situation and shape from the enlargement of the gland it is usually flattened from side to side (*scabbard trachea*) and often displaced an inch or more from the middle line the greatest displacement and most urgent dyspnoea being produced by the localized swellings of the gland. This is seen particularly in localized swellings which have enlarged downwards into the upper opening of the thorax (*retrosternal or intrathoracic goitre*) (Fig. 623). The degree of dis-

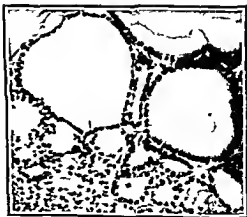


FIG. 624.—MICROPHOTOGRAPH OF COLLOID GOITRE.

placement of the trachea can be noted best by radiography the air in the trachea showing as a shadow it may be so marked as to produce stridor but never aphonia which is only found in cases where the recurrent laryngeal nerve is involved an occurrence rarely seen except in carcinoma of the gland The ordinary type of goitre is much more common in women than in men it does not appear to be hereditary and is not influenced by marriage

Colloid Goitre (parenchymatous or simple goitre) (Fig 652) consists of a diffuse overgrowth of the whole thyroid body the parts retaining to a great extent their normal proportions although one lobe is often larger than the other The most noticeable feature is the great increase in colloid material within the vesicles and the relative increase of the fibrous stroma (Fig 654) It is soft and elastic to the touch quite

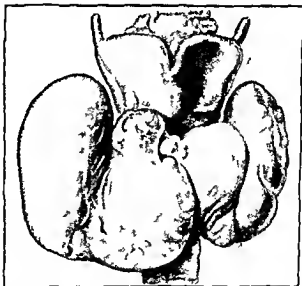


FIG 655 —NODULAR GOITRE (KING'S COLLEGE HOSPITAL MUSEUM)

painless and there may be some lobulation The amount of colloid accumulation may be so large as to give a cystic feeling while if the stroma of the gland is greatly in excess the tumour feels harder and there is more lobulation in some cases the increase of the stroma may be so excessive that insufficient gland substance is available for the needs of the body leading to myxoedema It produces no symptoms other than those associated with pressure from its increasing size

Nodular Goitre (adenoma fibro adenomatous goitre cystic adenoma) (Fig 655) The pathology of this condition has already been described Clinically it consists in the presence of one or more encapsuled nodules in the substance of the thyroid body which is itself often concurrently enlarged These nodules may occupy one or other lobe or when multiple may be scattered through the substance

of the organ occasionally they develop in the isthmus alone. If situated near the surface their limitation and free mobility in the gland can be easily detected but when placed deeply their special features cannot be recognized. The majority of these nodules are due to the hyperplasia involution cycle and consist of thyroid tissue which has undergone hyperinvolution and has been shut off by the increase of the stroma from the rest of the gland. A small number of nodules are of the foetal type. These latter are nearly always single and retain their characteristics independently of their age the former type of nodule may undergo changes. The whole internal stroma may disappear owing to pressure and the nodule consist only of colloid. Haemorrhage may take place into a nodule and then it increases rapidly in size or it may become secondarily infected through the blood stream.



FIG 656.—COLLOID GOITRE
INDICATING POSITION AND
SIZE OF COLLAR INCISION

In old standing nodules calcification sometimes takes place and in some cases such a stony nodule may be mistaken for a carcinoma when this doubt arises a correct diagnosis may be reached by radiography.

The Treatment of the colloid and nodular varieties of goitre may be considered together as they are different in nature from those which follow. In the early stages palliative measures can be employed consisting in the improvement of the general health correction of errors in the personal and sanitary hygiene and the administration of small quantities of iodine. In India cures are often produced byunction of iodides of mercury ointment the part being subsequently exposed to the rays of the sun.

In cases where in spite of such treatment the growth persists increases in size or gives rise to pressure symptoms

operative treatment should be undertaken in order to remove the localized swelling or a part of the gland. Total extirpation as already mentioned results in myxoedema but so long as a sufficient portion of the secreting substance is left whether it is derived from the isthmus or from one of the lobes no such sequela need be feared. In fact goitres should be treated much in the same way as new growths viz by removal when small there is still unfortunately a considerable tendency amongst practitioners and patients to leave them untouched until they are of large size thus greatly increasing the risk of the operation.

Partial Thyroidectomy is conducted as follows. A collar incision is made transversely across the neck four to six inches in length (Fig 656). The platysma and layers of deep fascia are divided and the sterno-mastoid sterno-hyoid and sterno-thyroid drawn aside or if need be divided. The lobe to be removed is thus exposed within its capsule.

which should then be opened. The upper and lower poles are defined by blunt dissection. The superior thyroid vessels are secured by double ligatures and divided; the middle thyroid vein is ligatured at the outer border of the gland and the inferior thyroid vessels are dealt with below special care being taken to avoid the recurrent laryngeal nerve by tying the vessels close to the gland. The lobe is now delivered into the neck by blunt dissection and the isthmus freed from the trachea. In detaching the latter the surgeon must not forget that the cartilaginous rings may have been softened or absorbed by pressure and that the walls of the trachea are easily wounded. The isthmus is divided and any bleeding vessels secured. The wound is closed with catgut sutures for the muscles and fascia and the skin sutured. A drain is introduced for twenty-four hours as it is difficult to employ pressure on the neck. Healing by first intention should be the invariable result and the scar almost invisible.

The question of anaesthesia in these operations has been much discussed. Some surgeons advise that local infiltration anaesthesia should always be employed; many others reserve that procedure for the worst cases and trust to a skilled anaesthetist to administer gas and oxygen after the administration of avertin to the majority of the patients. With this latter view we personally concur. In cases where there is marked pressure on the trachea as in intrathoracic goitre the intratracheal administration of gas and oxygen may be preferred.

In nodular goitre where the nodules are multiple or incompletely differentiated the affected lobe should be removed but if the nodule is single or a foetal adenoma is present it may be enucleated by dividing the skin and muscles as before incising the gland substance and capsule down to the swelling which is readily shelled out.

Toxic Goitre—This condition can be subdivided into two varieties primary or secondary. **Primary toxic goitre** (Graves' disease, or exophthalmic goitre) is as the name implies a disease occurring in a previously healthy gland while in the **secondary toxic goitre** (toxic adenoma) the symptoms of toxicity are superimposed on a gland which is already diseased either a colloid goitre or more commonly a nodular goitre.

In either case the gland is the seat of hyperplastic changes of a

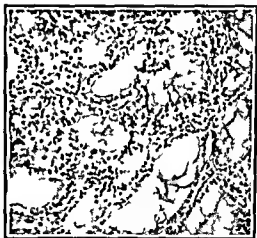


FIG. 637.—MICROPHOTOGRAPH OF EXOPHTHALMIC GOITRE

marked degree. In the primary form these changes are so prominent as to give a characteristic appearance to the cut surface of the gland which is fleshy looking with no obvious colloid in marked contrast to the translucent appearance of the colloid gland and with a fine net work of interstitial tissue. Microscopically the alveoli are small and crowded together with a small quantity of poorly staining colloid. Papillary proliferation of the columnar epithelium is present and there is marked increase in the vascularity of the gland (Fig 657). This characteristic appearance is lost when the patient has been given Lugol's iodine the gland undergoing an involution process in varying degree with increase in the colloid and fibrous tissue and a flattening of the papillary proliferations of the epithelium of the acini. In the secondary type the changes are not usually evident to the naked eye but

microscopically similar changes are noted. In the primary form more especially in the severe cases there is nearly always a persistently enlarged thymus the significance of which is not understood.

The Cause of the symptoms found in toxic goitre is not established. That the marked hyperplasia found in the gland is responsible there can be little doubt but whether its effects arise from an excess of normal secretion or from some abnormal secretion we do not know. Further the hyperplasia may be due to some metabolic factor necessitating an increased thyroid secretion and this may be the real cause of the disease.



FIG 658—EXOPHTHALMIC GOITRE

The clinical signs of Primary Toxic Goitre (Graves' disease) are characterized by a diffuse enlargement of the thyroid body which often pulsates forcibly owing to the increased vascularity of the gland and the dilation of the vessels (particularly those in the capsule) associated with marked anaemia, severe palpitation and cardiac irritability (tachycardia) and protrusion of the eyeball (exophthalmos or proptosis). The enlargement of the thyroid body is not always marked and may be scarcely noticeable. The patients usually affected are females about the early middle period of life whose menstrual functions are often impaired. Overwork, worry and severe mental or physical strain are apparently responsible in many instances for the onset of the symptoms and a sudden fright or shock accounts for others. The protrusion of the eyeball is a marked feature of most cases and is sometimes due to an increase of the orbital fat (Fig 658). Contraction of the so-called muscle of Muller (unstripped muscular fibres stretched across the sphenomaxillary fissure) has also been suggested

as a more plausible theory. When the patient looks down the upper eyelid does not immediately follow the eyeball allowing the white sclerotic to be seen between the lid and the cornea (Von Graefe's sign). A fine fibrillary tremor of the extremities and tongue is commonly observed in these cases. The patient is always extremely nervous with a moist skin and a high pulse rate and frequently a high blood pressure. Any exertion or excitement increases the irritability of the heart action and may induce considerable respiratory distress. In advanced cases the diseased heart may go on to fibrillation the nervous symptoms progress to mania while the patient may die from exhaustion following on severe attacks of diarrhoea and vomiting. The disease has definite remissions and may become completely cured during such a period with little treatment other than rest. On the other hand the exacerbations usually leave the patient worse than before with impaired general health and a weakened heart.

This exhaustion is to be accounted for by the fact that with the increased or vitiated secretion of the thyroid the metabolism of the whole body is enormously increased and the disease acts like a blast on a furnace leading to greatly increased consumption of fuel. In such cases by measuring the basal metabolic rate we can estimate the severity of the disease. Mild cases show an increase of 20 to 40 per cent while in severe cases the rate rises to 60 to 100 per cent. This metabolic rate gives an indication as to the progress or remission of the disease. Its use however should be restricted as the frequent estimation of the rate worries the patient and increases the symptoms.

Secondary Toxic Goitre has all the symptoms of the primary type usually without exophthalmos but with the added local signs of previous disease in the gland either in the form of a colloid goitre or more commonly a nodular goitre. It is usually seen in women of middle life who have had the local trouble for many years. The symptoms usually are not so severe as in the primary condition.

Treatment consists in freeing the patient if possible from all sources of irritation and worry by absolute rest in bed. Attention should at the same time be paid to sources of infection which are frequently to be found in the tonsils or mouth. The removal of these septic foci together with the rest is frequently all that is required in primary toxic goitre and a considerable percentage of cases recover. A most powerful form of medication has been reintroduced by Plummer for the treatment of these cases viz by Lugol's iodine (5 per cent iodine in a 10 per cent aqueous solution of potassium iodide). This solution given in small quantities daily (℥v vii tds) usually produces a marked lowering of the pulse-rate a decrease in the basal metabolic rate and a diminution of the nervous symptoms. In some of the worst cases Lugol's solution may be given intravenously, it may safely be administered in any dilution up to fifteen drops to a pint and can be given in glucose or saline solutions. Sometimes large doses of Lugol's solution will quickly perform what small doses although long continued have not been able to accomplish.

Unfortunately this improvement is not always maintained and the maximum benefit is seen after about eight to ten days although in

some cases it only appears after two or three weeks. If continued after this period the drug appears to lose its effect and a second course rarely produces as much benefit as the former. After a short course the patient reaches a condition in which operative measures can be undertaken with a greatly decreased mortality rate.

When medical treatment has not been effective or if there is an exacerbation of symptoms *operative treatment* must be considered. The mere suggestion of surgical measures to these patients usually produces a rise in the pulse-rate and a great increase in the nervousness and the advantage of a course of Lugol's iodine as a preliminary is at once obvious. As already mentioned the exhibition of iodine in these cases produces a marked effect on the thyroid which becomes firmer and very slightly nodular on its surface and on section has

no longer the beefy look of an untreated gland. The operative procedure required is the removal of about five-sixths of the gland; if less is removed the symptoms are likely to recur and a further operation is necessitated.

The gland is exposed as described previously and the upper pole on the right side divided between double ligatures thus securing the superior thyroid artery and vein. The lobe is thus freed and a series of artery forceps are applied to the posterolateral aspect of the lobe and the lobe sliced across towards the trachea thus leaving a small portion of the gland between the trachea and the oesophagus. The isthmus is then freed, and the removal of a portion of the lobe on the opposite side by a similar method completes the operation. Bleeding points are secured



FIG. 639. MALIGNANT GOITRE.

and tied, the muscles and skin are sutured and a drain introduced for twenty-four hours. A further course of Lugol's iodine is subsequently administered.

The choice of an anæsthetic in these cases is of great importance. Chloroform should never be given. Avertin gas and oxygen with local infiltration of the skin is most satisfactory, some surgeons preferring local anæsthesia with scopolamine and ornopon. Both these types of anæsthesia are suitable for those cases where the heart is fibrillating, the latter a type of case that appears desperate but in which brilliant results can be obtained.

Dunhill in a verbal communication states that out of 2,8 cases 27 (81.6 per cent) have regained normal rhythm with a 6.1 per cent mortality and the remaining cases not being traced.

With modern pre-operative treatment acute hyperthyroidism as a

post operative complication is rarely seen. A small percentage of the patients do not respond to Lugol's iodine and then it may be advisable to ligature the superior thyroid arteries and only after some improvement has occurred to remove a portion of the gland. When the patient stands operation badly it is always advisable to effect the needful removal of the gland in stages until a sufficiency has been taken away. A reappearance of toxic symptoms after the first operation usually indicates that an insufficient amount of gland has been removed. A period of six months at least is necessary before the full benefit of an operation is seen.

The treatment of secondary toxic goitre is similar to the primary with the exception that operative treatment should always be undertaken as these cases are never cured by medical treatment. Considerable controversy has arisen as to the benefit of Lugol's iodine in this condition. On the one hand it has been stated that no improvement is brought about and that iodine should not be given but other workers have stated that the response to iodine is essentially the same in the secondary as in the primary toxic goitre. A view with which we concur. Radio-therapy in the treatment of toxic goitre is said to be beneficial some cases no doubt are improved but in the majority operative treatment holds out a better hope of curing the disease.

Malignant Disease of the Thyroid Body (lig 659) may arise primarily or develop secondarily to a simple goitre and has somewhat diverse pathological and clinical features. (lig 660)

When secondary to a pre-existing goitre the change of type is indicated by a rapid increase in size by a change of consistency of the mass which becomes harder than previously as well as more nodular and fixed and by the presence of pain at first localized but subsequently more diffused around the head neck and shoulders. The trachea is compressed and in some cases perforated some amount of dyspnoea resulting. Hoarseness develops as a result of involvement of the recurrent laryngeal nerve and the main vessels are frequently surrounded by the growth and not much displaced outwards as in a simple goitre. Histologically the growth is usually a spheroidal-celled carcinoma (lig 661) and neighbouring lymphatic glands are enlarged and secondary deposits may occur in the distant viscera. The diagnosis of this type in the early stages when alone operative treatment is likely to be of use is not easy inasmuch as sudden increase in a goitre is



FIG 660—MALIGNANT GOITRE OCCURRING IN A WOMAN WHO WAS KNOWN TO HAVE A NODULAR GOITRE FOR TWENTY YEARS.

not unusual resulting from an intracystic hæmorrhage. The actual histological features of these cases are a little unusual as not only do different tumours vary but variations can be seen in the same tumour and it has a tendency to early involvement of the veins.

When primary cancer of the thyroid body occurs the diagnosis is suggested by the presence of a swelling which is from the first hard and without clear definition. The evidences of pain and pressure are marked at an early stage in the disease and the progress is steadily persistent. In another category must be included a few cases where the primary growth is so insignificant that it is entirely overlooked although distant deposits especially in the long bones and cranium may be so marked as to call for treatment such as amputation and

the condition is only recognized when the growth is examined histologically after removal.

Treatment by extirpation can be only undertaken in the early stages. Radium treatment should always be employed in inoperable cases as it frequently reduces the size of the growth and prevents or improves the pressure symptoms (Plate VIII)

The Parathyroid Glands are small ovoid bodies usually four in number situated behind the thyroid gland and generally near the termination of the inferior thyroid artery.

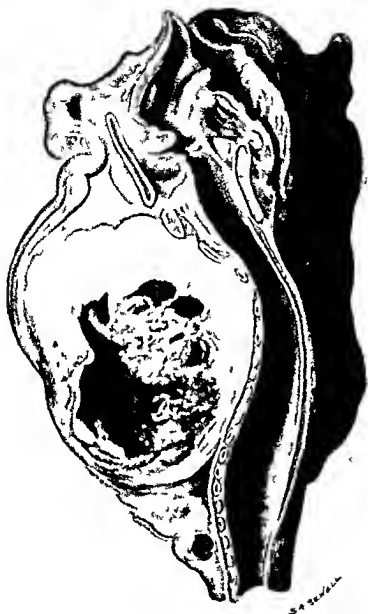
Microscopically they consist of columns of epithelial cells with large nuclei embedded in a rich capillary stroma. Spaces are often found in them containing a colloid material which is not considered identical with that found in the thyroid vesicles. Their function is not definitely known but their complete removal in animals causes acute convulsive attacks together with the condition known as tetany and death in a few days from coma. The tetany formerly ascribed to removal of the thyroid body is in reality due to disease absence or removal of the parathyroids. They also have considerable influence upon the calcium metabolism of the body. Post-operative tetany due to injury or removal of the parathyroid in operations upon the thyroid gland can be treated by giving parathormone and calcium. Tumours of the glands are associated with cystic disease of bones.

The Thymus Gland is an occasional source of trouble in that it persists and becomes enlarged instead of disappearing. Normally



FIG 661.—MICROPHOTOGRAPH OF CARCINOMA OF THYROID (X82)

PLATE XVIII



Carcinoma of the Thyroid
(Museum Royal College of Surgeons)

it reaches its greatest dimensions about the age of two years and then gradually wastes, so that by puberty it is represented by a mass of fatty tissue, with perhaps a few remnants of the original organ. Its persistence, and still more its enlargement is indicated by fulness of the root of the neck, dulness over the sternum perhaps by evidences of mediastinal pressure on the large veins and certainly by increasing dyspnoea. A *thymic asthma*, partaking of the nature of laryngismus stridulus has been described, but more important is the association of an enlarged thymus with generalized lymphatic hyperplasia and a large spleen in the condition known as *status lymphaticus*, which may be a cause of sudden death under anæsthetics. The thymus is generally enlarged in cases of Graves' disease that come to the post mortem table. Tracheotomy is useless in the treatment of the somewhat severe dyspnoea sometimes present, and operative interference for the removal of the enlarged gland has been undertaken with success in some cases. Lymphadenoma and lympho sarcoma have also been known to affect this organ.

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CHAPTER XXXVIII

DISEASES OF THE BREAST

Congenital Malformations of the breast are much more common than is generally supposed. One or more accessory breasts (*polymastia*) or nipples are found either below the normal one or just above it some-

times they have been found in the axilla on the outer side of the thigh or other unusual situations. They are often of a most rudimentary nature but in a few cases have secreted milk. Very rarely the breasts are entirely absent (*amastia*) (Fig. 662). Occasionally the male breast becomes enlarged to the ordinary size of a virgin's breast (*gynecomastia*) the organ is usually functionless since the overgrowth mainly affects the stroma although lactation has been known to occur. The condition may be associated with imperfect or irregular development of the sexual organs.

Diffuse Hypertrophy of the breast (Fig. 663) consists of a general enlargement of the organ both gland substance and interstitial tissue participating in the process and hence the breast becomes firm and indurated. It may be uni or bi lateral perhaps more frequently the latter and generally occurs in adolescents. The size varies considerably but the breasts



FIG. 62. ABSENCE OF LEFT BREAST IN A GIRL AGED SEVENTEEN.
The nipple is present.

may become enormous hanging down by their weight and perhaps to such an extent as to rest on the knees of the patient when sitting. They are usually painless although sometimes neuralgia is noticed. Function

ally they are useless as even if the patient becomes pregnant secretion of milk but rarely occurs. No cause can be assigned for the overgrowth and the only treatment is amputation, when the increased size is causing discomfort.

Affections of the Nipple.

Fissures of the Nipple (cracked nipples) seldom occur apart from lactation, and may usually be traced to a want of care and cleanliness on the part of the mother associated with a tender condition of the skin which might have been prevented by bathing the parts during the later weeks of pregnancy with spirit, so as to harden them. The actual lesion is brought about by leaving the nipples wet after nursing. The superficial layers of epithelium become macerated and are easily rubbed off thus exposing the more delicate and sensitive deeper parts which are irritated and inflamed by the repeated acts of suction. As a result, nursing becomes painful, and if persisted in, the wound may be infected, the inflammation spreading to the breast substance along the ducts or lymphatics, or extending along the superficial lymphatics to the axillary glands.

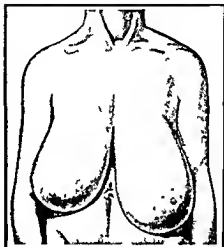


FIG 663 — DIFFUSE HYPERTROPHY OF THE BREASTS

It occurred in a girl aged sixteen and a half years and both organs had to be removed. The left breast weighed 9½ lbs the right breast 9 lbs.

Treatment—The best way to prevent the occurrence of cracks is to bathe the nipples with some dilute antiseptic, such as boric acid lotion, immediately after nursing, and then to dry them thoroughly and apply lanoline, which keeps them soft and supple. When a fissure has formed it should be dressed with cooling or antiseptic lotions, *e.g.* *lotio plumbi* or *lotio acidi borici*. Sometimes more stimulating applications are required, such as a solution of sulphate of copper, or even of nitrate of silver. It is also recommended to paint the sore with equal parts of glycerine and sulphurous acid.

Eczema of the Nipple may be of a simple nature, needing nothing but ordinary treatment, or it may take on special features, being then known as *Paget's Disease* (*dermatitis maligna*). This disease was first described by Sir James Paget in 1874 and since that date much controversy has taken place as to the exact pathology of the condition. Inglis of Sydney* has recently written an excellent monograph on the

* *Paget's Disease of the Nipple*. By Keith Inglis. Humphrey Milford Oxford University Press 1936.

subject and his views are accepted by most surgeons and pathologists of to-day. Paget's disease is a surface cancer commencing at the junction of the lactiferous ducts with the epidermis. The growth extends down the duct and the surface ulceration is not excessive. Large epithelial Paget's cells and active mitoses are characteristic of the microscopical section. Although the condition may remain limited to the epidermis and ducts for some years usually a scirrhous cancer forms in the substance of the breast. On clinical examination it presents a smooth red raw surface discharging a yellowish viscid fluid and may occasionally spread widely beyond the areola (Fig 664). The projection of the nipple disappears the raw surface being absolutely flat. Lym-



FIG 664—PAGET'S DISEASE OF LEFT NIPPLE

phatic glands are not involved but an associated carcinoma causes the usual lymphatic trouble. No local treatment is of any avail and the disease when once recognized with certainty is best treated by radical amputation including the axillary glands.

Paget's disease is rarely seen in parts other than the breast but it may occur on the abdominal wall, vulva, cervix uteri and the glans penis.

Abscess of the Areola is not uncommon in young girls about the age of puberty arising in the sebaceous follicles and requiring no special notice.

Chancre of the Nipple (Fig 665) is rarely seen in the mothers of syphilitic children (Colles's law p 175) but much more commonly in wet nurses. It usually presents as a shallow ulcerated surface with a well marked raised and indurated border. No uncommonly the condition is symmetrical.

Keratosis of the Nipple is a rare condition in which the nipple is replaced by a warty growth which constantly breaks off. The nipple



FIG 665—CHANCER OF THE NIPPLE

disappears and is replaced by a depression filled with irregular horny masses. No satisfactory treatment has been discovered as yet but X rays may prove beneficial.

Primary Tumours of the Nipple are met with such as papilloma sebaceous cysts and occasionally epithelioma.

Inflammatory Affections of the Breast

Acute Mastitis is most often observed in *puerperal* women of an anæmic weakly type and usually results from a sore or cracked nipple through which pyogenic organisms find their way into the lymphatics or acini of the breast substance. In the former case the inflammation is mainly interstitial in character the pus diffusing itself widely between the lobules in the latter the pus is primarily intra alveolar. In *non puerperal* women acute mastitis may result from injury or may be pyæmic in origin. Occasionally a meta static inflammation of the breast occurs after the disappearance of the parotid swelling in mumps whilst in girls and even in boys about the age of puberty a subacute inflammation is not unusual. A slight enlargement with congestion of the breasts often occurs soon after birth and occasionally terminates in suppuration.

Signs and Symptoms—An inflamed breast is characterized by the organ becoming swollen acutely painful and tender. The gland lobules are enlarged and indurated and if lactation is progressing the secretion is to some extent impaired but owing to the inability of the mother to allow the child to relieve the organ on account of the pain produced thereby considerable tension results from accumulation of milk. If suppuration follows the skin over the breast becomes red and œdematous and according to the situation of the pus three different forms are described (a) *Supra mammary abscess* is a collection of pus in the subcutaneous tissues or beneath the nipple it is often unconnected with the organ and comes readily to the surface (Fig 666) (b) An *intramammary abscess* is the most common variety the pus developing within and distending the lobules or infiltrating the cellular tissue around them it is usually diffused widely throughout the organ and may point at several spots. When very acute or in debilitated women especially if it has been allowed to progress without treatment the inflammatory process may actually determine gangrene of the glandular tissue (c) A *submammary abscess* forms in the cellular tissue

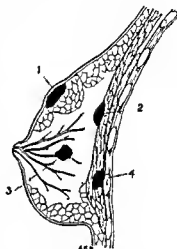


FIG 666 — VARIETIES OF ABSCESS OF THE BREAST

- 1 Supra mammary 2 submammary 3 intramammary 4 retro mammary

beneath the breast. It may spread from the deep lobules but more frequently results from disease of some of the adjacent ribs or cartilages or starts as a cellulitis. In these cases the breast is pushed forwards and becomes prominent floating as it were on a bed of pus. The abscess usually points at the periphery of the organ perhaps in several places but most commonly at the lower and outer quadrant.

The Treatment of simple acute mastitis consists in the first place in supporting the inflamed gland by means of a sling or bandage and in binding the arm to the side so as to keep at rest the pectoral muscle on which it lies. Fomentations are applied and any tension due to retained secretion is relieved by the breast pump. The bowels are opened and the patient placed on a light and nourishing diet.

If the condition quiets down gentle friction of the part with warm oil or with belladonna ointment is often helpful in completing the process of resolution.

If however the part remains hard and swollen with marked tensive pain and the temperature raised suppuration is obviously threatening and the surgeon must not be tempted to wait for the appearance of fluctuation before he opens up the abscess. Persistent oedema under these circumstances is quite sufficient indication that operation is required. Above all the abscess must never be allowed to burst into or under a poultice for then chronic suppuration and the formation of sinuses will almost certainly result from the mixed infection thereby determined.

In the *supramammary* variety it matters little in which direction the cut is made since the pus is always superficial to the breast tissue. In the true *intramammary abscess* the incisions should radiate from the nipple. One or more may be needful and these should be made with a free hand so as to allow of the insertion of the finger and the opening up of any pockets or lobules which are distended with matter. A large drainage-tube is inserted for a time and gradually shortened day by day until its entire removal is permissible. When the chief incisions are needed above the nipple it is often wise to make a counter opening in the lower half of the breast and generally on the outer side to permit of more efficient drainage. With such treatment the best of results may be attained and it is interesting to note how quickly the contour of the breast is restored and how slight is the permanent injury inflicted on the parts. The *submammary abscess* is best opened towards the lower and outer side but also at any spot where pus points.

If discharging sinuses persist after an abscess has burst their orifices should be enlarged and their walls thoroughly scraped and disinfected. Deep cavities should be efficiently drained and packed with gauze so as to ensure the wounds healing by granulation the arm must also be kept to the side.

Chronic Lobar Mastitis is by no means unfrequent as a result of imperfect involution of the organ at the cessation of lactation but may arise from blows or squeezes and especially in young women it may also follow a subacute or acute attack which has not ended in suppuration. It is characterized by an enlargement of one or more lobes of the organs which are usually tender and often excessively

painful the pain being of a neuralgic character and increased during menstruation. The condition is of comparatively little importance but may give rise to a great deal of anxiety and worry. All that is necessary in its **Treatment** is to support the part and keep the arm at rest in a sling whilst an ointment containing belladonna or a bella donna plaster may be applied.

Chronic Interstitial Mastitis is an affection which occurs not unfrequently in women with small or atrophic breasts who have passed or are near to the climacteric. It is also met with at an earlier age in unmarried women involving the whole of one or both breasts or limited in its development to a portion of one breast and is then sometimes mistaken for a malignant tumour.

Pathology—A considerable amount of attention has been drawn to this condition during the past few years by Sir Lenthal Cheatele who claims that there are good reasons for doubting the inflammatory nature of this affection and has introduced a completely new nomenclature in connection with it until however more knowledge and information about doubtful points have been obtained it is scarcely wise to discard the old. The essential feature in the process is hyperplasia of both the connective tissue of the breast and the epithelium but which is to be looked on as the originating factor is open to question. The diffuse overgrowth of the connective tissue around and between the acini renders the gland hard and knobby. Epithelial proliferation involves both the ducts and the acini at first the proliferated cells become detached into the alveoli and collect in small cyst like spaces to constitute a colostrum like effusion. Later on the cells remain attached to their base of origin and the alveoli may be choked up with this new formation. Another stage consists in the growth of papilli form processes covered by epithelium which grow into dilated spaces. After a time the epithelial cells in any of these forms may change their type and become malignant in character and then penetrate into the connective tissues and constitute a cancerous growth. A certain amount of fluid exudate occurs within the acini and may originate cysts in which the content is clear or turbid according to the number of cell elements present. As a rule many of these cysts are scattered widely through the breast substance but they are usually small and insignificant occasionally one of them becomes notably enlarged and simulates a tumour especially when covered in by a mass of thickened glandular tissue.

Clinical History—The condition often passes unnoticed in the early stages until a distinct lump has formed which is nodular and indurated to the touch and often very painful. The breast may be somewhat enlarged and there is perhaps some retraction of the nipple owing to contraction of the interstitial tissue but this is by no means usual. A scanty serous discharge from the nipple is sometimes noticed. The skin seldom becomes adherent to the swelling whilst the lymphatic glands in the axilla may be enlarged and tender but they are never hard. On careful examination of the breast the affection is rarely found to be limited to one particular region for although a distinct enlargement of one portion may be present yet the whole organ feels

more or less 'lumpy' and not unfrequently the other breast participates in the same change. Small rounded elastic spots can often be detected and indicate the presence of cysts. There may be but little pain although this is sometimes one of the most marked features of the case: it is of a neuralgic type and usually increased at the menstrual periods.

If left to run its course the disease may remain much in the same condition for many years and even in time disappears but more

frequently it slowly progresses and then results in one of three conditions: (a) *General atrophy*, the breast becoming shrunken hard and nodular; (b) More frequently *general cystic disease* (Fig. 667) follows a condition in which the organ becomes transformed into a number of cysts held together by dense connective tissue; (c) In not a few cases *cancer* is a sequela of this disease: there is abundant evidence to prove that any continued source of irritation in an organ like the breast renders an individual with a cancerous inheritance more liable to its development especially if it commences at or about the climacteric.

The **Diagnosis** is sometimes easy but the condition often simulates somewhat closely a scirrhus tumour. The chief points of distinction however lie in the facts: (i) that the whole breast is more or less involved; (ii) that the opposite organ is very often similarly affected; (iii) that enlargement of the axillary glands is less common than in scirrhus and even if enlarged they are not hard as in the latter disease; (iv) that the skin is usually free from the mass; (v) that the tumour is never adherent to the pectoral fascia nor is it of the stony hardness of a scirrhus; and (vi) that it is often more disseminated and less defined than a cancerous growth. (vii) Moreover on careful palpation with the flat of the hand it is often impossible to make out any distinct lump.

the so-called tumour merging into the surrounding tissues: this never occurs in scirrhus the growth always being easily detected with the flat of the hand. Small cysts can also be felt as localized elastic spots in the inflammatory mass. Of course it is possible for the two conditions to co-exist for a careful microscopic examination of these breasts after removal often reveals the presence of a cancerous nodule when there is no clinical evidence of its existence.

Treatment—In the early stages and especially in the younger patients friction with some sedative application containing bella



FIG. 667.—GENERAL CYSTIC DISEASE OF THE BREAST RESULTING FROM CHRONIC INTERSTITIAL MASTITIS.

In this case both breasts were equally affected and were removed at the same time.

donna may be used at the same time that the breast is supported Firm and equable pressure as by strapping, is also useful in some cases, whilst iodides may be administered If a definite tumour is present, or if many cysts can be detected and especially if the patient is anxious and worried about herself, it is wise to remove the affected portion, or even better to excise the whole breast especially when there is a family history of malignant disease

Localized or Encysted Chronic Abscess usually occurs in women who have borne children, and may arise in connection with a retention cyst or be of the residual type It is characterized by the formation of an indurated mass in the breast substance, which slowly softens giving rise to a sense of fluctuation, although when the abscess walls are very thick, as is often the case, this may be difficult to detect Retraction of the nipple is not uncommonly present, and the axillary glands may be enlarged The condition may closely resemble a carcinoma and indeed in not a few cases the breast has been completely removed owing to a mistaken diagnosis Sometimes, however, it is possible to detect a feeling of elasticity at the centre which is almost always less resistant than the margin, whereas the opposite is the case with a tumour When in doubt, the introduction of a grooved needle or an exploratory incision should precede a radical operation A localized excision is all that is required for the cure of this type of case

Diffuse Tuberculous Disease of the breast is not very uncommon Scattered nodules of caseous material are developed in the interacinous tissue, which break down into pus, and come to the surface at various spots The breast may thus become riddled with sinuses discharging caseous pus It may be associated with tuberculous disease of the lungs whilst a like affection may arise secondarily in the axillary glands, possibly in some cases the primary trouble lies in the glands, the breast being subsequently involved

Treatment should be carried out, if possible, by incision, scraping and purification of the cavities, but if the tuberculous foci are multiple it is wiser to amputate the breast

Occasionally a *chronic tuberculous submammary abscess* forms as a result of disease of the ribs or costal cartilages It develops slowly, pushing the breast forwards and is easily recognized although its cause can only be ascertained by exploration Aspiration may suffice for its cure, although open treatment may be required for the affected bone

Syphilitic Diseases of the Breast—As already pointed out, a primary sore may be met with on the nipple secondary mucous tubercles, or condylomata, are found in a similar situation or beneath a pendulous breast, whilst superficial and deep gummata have in rare cases formed in the tertiary period of the disease

Cysts of the Breast.

When the structure of the breast, its abundance of ducts and alveoli, and its complex lymphatic distribution are considered, it is not surprising that many different forms of cystic change are associated therewith The following are the more important

I Acinous or Retention Cysts arise as the name suggests from some obstruction to the ducts or lobules whereby the secretion of the organ is unable to escape. They are met with most frequently in women during or after the puerperal period a milk cyst or *galactocoele* being then produced. It usually results from compression of one or more of the ducts connected with a sore nipple and contains in spissated milk. It forms a rounded swelling and is located under the areola. The wall is lined with epithelium and surrounded by a fibro-vascular layer the thickness of which increases with the chronicity of the case. In very old standing cases the fibrous wall becomes very dense and may cause retraction of the nipple and puckering of the skin closely simulating a scirrhus. The condition is treated by excision.

Similar glandular cysts form as already described in the course of chronic interstitial mastitis and in elderly women are known as *involution cysts* in long standing cases general cystic disease of the breast may follow.

Retention cysts have also been described as resulting from irritation of the nipple as for instance when a young non pregnant woman constantly puts a baby to her breast. It may also occur apart from such irritation in young and vigorous unmarried women as an expression of the inherent capacity of the gland for functional development. The organ becomes enlarged the epithelium proliferates and a thin serous fluid is secreted which does not entirely escape and by its distension of the lobules gives rise to what may be termed *irritation cysts*. They may in time undergo spontaneous absorption but Erichsen described a case of this nature in which the swellings did not disappear until the patient subsequently became pregnant. Chronic interstitial mastitis may sometimes supervene.

Again one frequently finds cystic dilatation of the ducts and lobules arising in connection with certain tumours of the breast such as duct papilloma duct cancer or cysto-adenoma. In these cases hæmorrhage from the contained growth is often seen giving rise to a blood stained discharge from the nipple. A scirrhus growth also occasionally starts from the wall of an acinous cyst.

In most of these retention cysts discharge from the nipple occurs on squeezing the organ.

2 Interacinous Cysts develop in the interstitial tissue of the breast.

(a) **Serous Cysts** originate from a dilatation of lymph spaces. They may be uni or multilocular perhaps more frequently the latter. They are lined by a smooth shiny layer of endothelium and contain serum perhaps blood stained and in old standing cases cholesterol being separate from the gland substance they never give rise to a discharge from the nipple and intracystic growths are unknown. They are usually surrounded by a wall of connective tissue which may become exceedingly thick and dense. Occasionally however they project under the skin and if the walls remain thin fluctuation and even translucency can be observed leading to the condition sometimes badly termed a *hydrocele of the breast*.

The Diagnosis of a serous cyst if the wall is thick is often a matter of considerable difficulty as it resembles in many ways a scirrhus.

It is recognized however by the facts that the growth is incorporated with the breast substance usually occurring near its under surface that on careful examination an elastic resistance is transmitted to the fingers quite distinct from the stony hardness of a scirrhus that there is no retraction of the nipple and no enlargement of the axillary glands whilst as a rule the patient complains of but little pain. The diagnosis in cases of doubt may be readily determined by inserting a grooved needle or by an exploratory incision which should be made of sufficient depth to ensure the thorough division of the mass for fear that a small cyst surrounded by walls of fibrous tissue half an inch or even an inch in thickness should be mistaken for a solid tumour.

Treatment—Such cysts should be removed.

(b) **True Hydatid Cysts** are occasionally met with manifesting the general characteristics described at p 241.

3 Cysts may also arise in connection with cancerous or sarcomatous tumours from degeneration of tissue in the former case and from hæmorrhage into the substance of the latter.

Tumours of the Breast

In investigating any case of tumour of the breast the surgeon must never arrive at a hasty conclusion but only give an opinion as to its nature after careful and detailed examination. Thus the age and



FIG 668 — EXAMINATION OF THE BREAST WITH THE FLAT OF THE HAND



FIG 669 — TESTING THE FIXITY OF A TUMOUR OF THE BREAST

previous history of the patient should be considered as also the family history. Simple tumours generally arise at an earlier date than the malignant whilst the sarcomata usually affect younger individuals than the carcinomata. There can be little doubt moreover as to the occasional tendency of tumours to run in families. The length

of time for which the swelling has been observed should be ascertained, and whether or not it varies in size at the menstrual periods. The general appearance of the patient should be noted as also the fact whether or not pain local or neuralgic is experienced. It is not unusual for pain to be referred to that part of the shoulder supplied by the posterior division of the second intercostal nerve, the anterior branch of which goes to the breast. A careful inspection of the organ should then be made with the patient sitting and lying down comparing it with the opposite breast so that any signs of asymmetry may be noted. Duppling of the skin, projection of the tumour or of the whole gland, and the situation and condition of the nipple are the chief points to which attention should be directed. Examination of the tumour with the flat of the hand (Fig 668) accompanied by gentle pressure



FIG 670 EXAMINATION OF THE AXILLA FOR ENLARGED GLANDS

The patient's arm is abducted so as to allow the surgeon's fingers to palpate the first intercostal space



FIG 671—EXAMINATION OF AXILLA CONTINUED

The patient's arm is lowered and the whole of the axilla can then be palpated

of the finger tips must then be undertaken, it is not enough to pick up the breast substance between the fingers, as thereby false impressions are obtained. The relation of the tumour to the gland, its shape, its consistency, whether fluctuating or not, and its mobility on superficial, deep, and surrounding parts, should all be investigated. To this end the breast must also be examined with the patient's hand pressed to the hip so as to put the fibres of the pectoralis major into action (Fig 669), transverse movement of the organ across the fibres is always possible unless the growth is fixed to the thoracic wall, movement in the direction of the fibres is at once limited if the tumour has invaded the muscle or even if the overlying fascia is seriously involved. Finally, the lymphatic glands in the axilla must be carefully examined

(Figs 670 and 671) as also the supraclavicular glands and the opposite breast and armpit

The chief types of tumour met with in the breast may be arranged in three groups the adenomata the sarcomata and the cancers. A few other conditions have been observed but are so rare that they need no special description *eg* lipoma fibroma chondroma and osteoma

Adenomata of the Breast are the most common innocent type and occur mainly in two forms the peri and intracanalicular they are both characterized by the existence of spaces lined with epithelium which does not extend beyond the basement membrane. The pericanalicular (Fig 672) shows increase

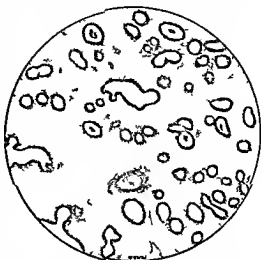


FIG 672—PERICANALICULAR ADENOMA

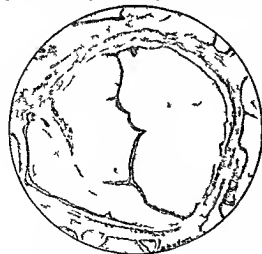


FIG 673—INTRACANALICULAR ADENOMA

in the interstitial tissue between the acini which although narrowed are still in most cases patent. Cellular infiltration epithelial hyperplasia and cystic changes are frequently present. These tumours correspond to the fibro adenomata of the older nomenclature and may be hard or soft according to the characters of the stroma. The intracanalicular type (Fig 673) is caused by a marked increase of the cellular fibrous tissue beneath the epithelium which grows out from the wall of the acinus or duct in papillary masses which may occlude the lumen or determine cyst formation. The original fibrous stroma remains intact or is stretched to accommodate itself to the new growth. This variety represents the cysto-adenoma formerly described. Sometimes the newly formed intracanalicular masses become very large and bursting through the skin fungate

giving rise to the so-called sero-cystic sarcoma of Brodie but there is nothing malignant about them. Occasionally both forms of adenoma are found in the same breast.

The Hard Fibro-adenoma (or Pericanalicular Adenoma) is the most common mammary tumour met with in young people before the age of thirty. It is often attributed to a blow or squeeze and doubtless correctly. It occurs as a more or less rounded or oval mass which if placed superficially moves freely in the breast substance and indeed may be described as floating in it (Fig. 674) if situated deeply it still

appears quite movable but its definition is less evident. Sometimes several such growths are found in the same breast. A fibro-adenoma is usually firm and more or less elastic in consistency of slow growth and it may be either painless or in anæmic and neurotic women exceedingly painful the pain often increasing at the menstrual periods. There is no concurrent enlargement of the axillary glands unless arising from other causes and no retraction of the nipple with which it is entirely unconnected.

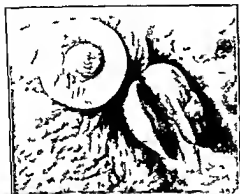


FIG. 674. PERICANALICULAR FIBRO-ADENOMA MAMMÆ (FROM MUSEUM OF ROYAL COLLEGE OF SURGEONS)

the skin over it does not dimple. The general health is unimpaired unless the patient is suffering from an associated anæmia. On section the tumour is of a greyish white colour becoming pink on exposure to the air and the cut surface slightly bulging. It is more or less foliated in texture being compared by Virchow to the section of a cabbage; no juice can be obtained on scraping the cut surface with a scalpel although on pressure some fluid of a thick glutinous or mucoid nature may escape. The tumour is distinctly encapsuled except at the one spot through which vessels enter and at which it is connected with the neighbouring mammary tissue.

The Diagnosis is readily made if the above signs are considered. An adenoma differs from chronic interstitial mastitis or a serous cyst by its exact definition and free mobility, whilst from malignant tumours it is distinguished by its slow rate of growth and its freedom from adhesions either to the skin or to surrounding parts. In women over forty great care should be taken as early malignant tumour may be mistaken for an adenoma.

The Treatment consists in its removal which is easily effected by cutting down upon the tumour in a direction radiating from the nipple until the capsule is reached when the mass is enucleated from its surroundings with a few touches of the knife. When the growth is

situated deeply in the upper half of the breast a crescentic incision may be made along the lower and outer border of the organ, and by burrowing upwards the breast can be turned over sufficiently to permit the tumour to be removed from the deep aspect, the scar will be subsequently hidden (Fig 675)

The **Soft Fibro-adenoma** is a rare tumour, differing from the above mainly in the increased rate of growth, in its soft consistency and in the fact that the interstitial tissue is of a more embryonic character it is sometimes incorrectly termed an adeno sarcoma. It usually occurs in women at a somewhat earlier period of life than cancer viz between the ages of twenty-five and thirty five. It may consist from the first of a localized tumour, increasing rapidly in size, or it may possibly commence as a hard fibro adenoma, which after remaining quiet for a time, takes on a more active development. It remains however, throughout its course strictly encapsuled, and when large may lead to pressure atrophy of the true gland substance. It is soft and elastic in consistency, usually painless and freely movable on the surrounding breast tissue. The skin over it remains healthy, although distended and atrophic when the tumour is of large size, the nipple shows no sign of retraction, the axillary glands are not involved, and there is no systemic invasion. On removal the section is similar to that of a fibro adenoma, but cysts are often present, as also areas of mucoid softening somewhat resembling sago. It can be readily removed in its entirety, and does not tend to recur.

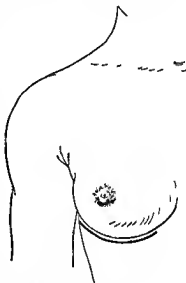


FIG 675—DIAGRAM OF THE INCISION FOR REMOVAL OF FIBRO ADENOMA

Cysto-adenoma (*Syn* **Cysto-sarcoma**, **Adenocoele**, **Intracanalicular Adenoma**, etc)—This rare tumour is characterized by a marked development of intracystic growths within the dilated acini of a newly formed mass of adenomatous tissue, or within the smaller ducts. It usually has a definite capsule, and then the normal gland tissue may be pressed aside and perhaps atrophied. Several cysts are, as a rule, present, and may be of great size. The intracystic growths also vary, sometimes there is only one large cauliflower-like mass in a cyst, sometimes there are several smaller pedunculated growths, they are exceedingly vascular, and hæmorrhage into the cavity of the cyst frequently occurs as also a blood stained discharge from the nipple. The tumour produced is irregular or lobulated in outline, owing to the projection of the cysts (Fig 676), it is usually painless, and unaccompanied by enlargement of the axillary glands,

if of large size blue veins are seen coursing over it. In the later stages the capsule becomes adherent to the integument and finally, owing to the pressure of the tumour the skin may give way allowing the growth to protrude. This will be followed by the development of a fungating mass which bleeds readily and becomes extremely offensive. With care a probe can be passed between the intracystic portion of the growth and the thinned and stretched skin which has merely given way and is not incorporated with it; this fact is a ready means of distinguishing this condition from a fungating malignant tumour. The growth is essentially benign in nature; it is never disseminated generally and if completely removed there is no recurrence. In the early stages it is often unnecessary to take away the entire breast but in the later stages the whole organ should be excised.

Somewhat similar in nature to the above is the condition known as a duct papilloma. This is characterized by the development of a soft polypoid papillomatous mass generally of small size in the interior of one of the terminal galactophorous ducts which in consequence becomes dilated. A discharge of blood stained serum results and there is usually but little tumour to be felt although the nipple may

be slightly pushed forwards and rendered prominent. It is often the precursor of a duct cancer. Amputation of the breast will in many cases be needed but it may be feasible in some to deal with the tumour alone.

Sarcoma of the Breast is not a common disease (2 to 8 per cent of all mammary tumours). It originates in the connective tissue of the organ being deeply placed in its substance or per-



FIG. 676.—CYSTO-ADENOMA MAMMÆ.

haps more frequently developing in the outer and upper quadrant. It is of two chief types. (a) The *round celled* sarcoma forms a soft, somewhat elastic swelling which grows rapidly and although often limited at first by a fibrous membrane the capsule sooner or later yields allowing the growth to become diffused through the organ. It sometimes gives rise to secondary growths in the axillary glands or becomes disseminated throughout the body by means of the bloodvessels. Myxomatous changes are also not unfrequently observed and in the more rapidly growing recurrent tumours the mass is often a true myxo-sarcoma.

PLATE XIX



Sarcoma of the Breast
(Museum, University College Hospital)

It usually occurs in women between the ages of thirty and forty : *e* somewhat earlier than scirrhus whilst its rapid growth and the absence of retraction of the nipple or dimpling of the skin are useful diagnostic features. Should pregnancy follow the tumour may increase in size at an alarming rate. In the infiltration form (Fig 677) it is almost impossible to distinguish it from encephaloid cancer except on microscopic examination (see Plate XIX). (b) A spindle celled sarcoma or fibro sarcoma is also met with forming a rounded or oval tumour more limited than the above and growing less rapidly. It somewhat simulates an adenoma but is more closely connected with the breast substance. The axillary glands are but rarely involved and the sarcomatous nature is recognized by the microscope and by the great tendency of the growth to recur even after apparently complete removal on account of this latter feature the name of recurrent fibroid tumour (Paget) was formerly applied to it. The recurrences generally take place at gradually diminishing intervals and the tumour may then become softer and more vascular occasionally the tendency to recur seems to wear itself out after the performance of several operations. Treatment consists in the removal of the entire organ at as early a date as possible together with the axillary glands followed by suitable irradiation.



FIG 677—SARCOMA OF THE BREAST

Cancer of the Breast

No organ of the body with the exception of the uterus is more frequently the seat of cancer than the female breast. It also occurs in the male subject but is about a hundred times less common than in the other sex.

Ætiology—Cancer of the breast is usually met with after the age of forty although the disease may occur at a much earlier date. It equally affects women who have borne children and nulliparæ and the question whether or not the woman has nursed her children seems to have but little influence. The left breast is more often affected than the right. It is frequently attributed to some injury such as a blow or squeeze.

It is associated with Paget's disease of the nipple and chronic interstitial mastitis. Heredity may be a marked feature in some cases but more often it is a factor of no importance.

Two distinct types of cancer are met with in the breast *viz* the

spheroidal celled acinous cancer (including the acute form, and the more chronic type known as scirrhus) and duct cancer. Colloid degeneration of either of the former varieties has been observed, but is very uncommon.

1 **Spheroidal-celled Acinous Cancer** includes the great majority of cases. The division into scirrhus and acute cancer depends clinically on the rate of growth and degree of hardness, pathologically on the greater or less amount of fibrous stroma present.

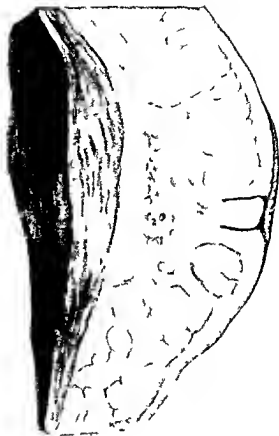
Scirrhus usually commences as a hard circumscribed mass, situated most commonly in the upper and outer quadrant of the organ. It is closely united to, if not absolutely incorporated with, the breast substance and on careful digital examination its margin is quite indefinite. In the early stages it is entirely distinct from the skin,



FIG. 678.—ADVANCED SCIRRHUS CARCINOMA OF THE LEFT BREAST.
The retraction of the nipple and the shrinking of the breast are well seen.

which moves freely over its surface, but as growth proceeds the stroma contracts and by dragging on the suspensory ligaments of Cooper passing from the glandular substance to the skin, the latter structure becomes more or less fixed, and hence on attempting to move it upon the tumour an appearance of dimpling results. At the same time the whole breast is acted upon in a similar manner, so that the affected organ sometimes seems to be smaller than the other, and, since the upper half of the gland is usually affected, the nipple may be drawn up so as to lie at a higher level than its fellow, as well as being retracted from the drag of the growth on the galactophorous ducts (Plate XX). The tumour itself is rarely of great size, so long as it retains its scirrhus nature, it is sometimes extremely painful and tender but not uncommonly the pain is intermittent and of a neuralgic type, extending to the shoulder, and perhaps only elicited on manipulation. As the

PLATE XX



Carcinoma of the Breast
King's College Hospital (Museum)

The skin may be implicated in many ways. (a) The dimpling which is met with over the tumour in the early stages has already been mentioned. As the case progresses the cancer extends outwards along the suspensory bands of fascia so that the skin itself becomes invaded, feeling firm and brawny, and looking congested and purplish in colour whilst a branny desquamation is usually present. A crack or fissure at length forms, giving exit to a little serous discharge, which at first scabs over, but finally leaves an ulcerated surface, which slowly extends, and may attain considerable dimensions. A typical *scirrhous ulcer* is hollowed out and excavated, its surface, if kept clean, is covered with smooth granulations, discharging a considerable amount of sanious fluid but if neglected, it becomes sloughy and offensive, it is surrounded by a projecting elevation of the tumour substance, forming a sort of

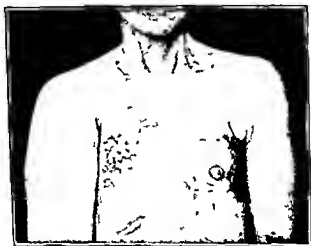


FIG 681.—(EDEMA OF THE ARM IN CANCER OF THE RIGHT BREAST
The breast has been removed and a recurrence taken place

rampart around it. (b) Less commonly the disease becomes disseminated through the lymphatics of the skin, giving rise to a series of firm cord like thickenings radiating from the nipple (Fig 680). The skin itself is thickened and firmer than usual, so that it is impossible to pinch it up, the mouths of the sebaceous glands are enlarged and very evident giving it a coarse appearance like 'pig skin,' or the rind of an orange (*peau d'orange* of French authors). Later the colour becomes dusky, and numerous button like nodules of cancer develop here and there, the sebaceous glands may exude an abundant secretion, which becomes inspissated on the surface into crusts or scabs, which are independent of any ulceration. This process often extends widely beyond the limits of the breast, invading the whole thoracic wall, and even running over the shoulder to the back of the head or neck (cancer *en cuirasse*), in its most typical form it is slow in development, the patient

perhaps living for many years (c) Occasionally one meets with a much more rapid form of cancerous lymphangitis in which the skin becomes affected with what is supposed to be a weeping eczema the surface is red hot and infiltrated and on examining it with a lens the dilated lymphatics can be seen from which the secretion oozes. The process spreads widely and rapidly and cancerous nodules appear here and there in the infiltrated area the prognosis is of course very grave.

In the later stages the patient passes into a state of cachexia becoming emaciated and exhausted. Ulcerated surfaces of considerable size may exist and the tumour is fixed to the thoracic wall even invading the ribs. The arm on the affected side is swollen and brawny owing to the pressure of enlarged glands on the main lymphatics and veins of the limb constituting a condition of solid or lymphatic œdema (Fig 681). Severe neuralgic pain of the arm results from involvement of or pressure upon the brachial nerves in the supraclavicular fossa. Secondary deposits develop in the viscera especially the pleura lungs and liver. Not unfrequently the connective tissue between the rib cartilages and the pleura is invaded and nodules of growth develop which may in time project for wards through one of the intercostal spaces (usually thesecond). Deposits in the bones are also not unusual the sternum ribs vertebrae and upper ends of the femur and humerus being most often affected. Severe pain is caused by such lesions followed perhaps by spontaneous fracture which may heal effectively or remain un united. Finally death from exhaustion ends the scene.



FIG 682 —MICROPHOTOGRAPH OF ENCEPHALOID CARCINOMA OF THE BREAST (X82)

Medullary (encephaloid) carcinoma or as it is often called acute cancer is fortunately not common and appears as a somewhat soft rapidly growing tumour which quickly infiltrates the whole organ and gives rise to secondary lymphatic and visceral affections at a much earlier date than scirrhus. Histologically the stroma is scanty the epithelial cells are spiroidal or in places almost columnar (Fig 682). It does not cause retraction of the nipple or dimpling of the skin the latter structure being distended and with blue veins coursing under it. The breast becomes enlarged and prominent the skin is stretched and gradually invaded by the tumour and if ulceration follows a foul fungating mass sooner or later sprouts up through the opening (Fig 683). This variety usually attacks young women under thirty five years of

age and runs a rapidly destructive course especially if it occurs during pregnancy or lactation when it is likely to be mistaken for an acute mastitis

Finally in elderly women a chronic form of cancer is met with known as Atrophic Scurrhus, in which the disease last for many years without much definite extension. Cases have been known to persist for fifteen or twenty years the patient at length dying of some intercurrent malady although in the great majority dissemination has ultimately occurred. The special characters are due to the excessive contraction of the stroma as a result of which the cellular elements become crushed and practically destroyed. The nipple is deeply retracted and the

tumour and breast substance in the most marked cases are scarcely discernible

2 Duct Cancer is a somewhat rare form of the disease the exact nature of which is still uncertain and there is very little doubt that several distinct types have been described under this name. It is sometimes characterized by the development of one or more nodules of a malignant papillomatous nature within the dilated ducts and usually situated not far from the nipple. These growths are covered with columnar epithelium and may indeed be looked upon as forms of columnar cancer. They are exceedingly vascular and a blood stained discharge from the nipple is usual. They always grow slowly and when situated near the skin



FIG 683. ULCERATIVE CARCINOMA OF THE LEFT BREAST

give rise to a round dusky red swelling. The nipple is not retracted and lymphatic enlargement not constant. In other cases the dilated alveoli are occupied by masses of proliferated epithelial cells of a spheroidal type which arrange themselves into more or less definite papillomatous growths whilst cystic degeneration also occurs. Either of these varieties may be associated with a development of ordinary scirrhus in some other part of the breast. The diagnosis can only be established with certainty by microscopic examination.

Adeno-carcinoma is the term given by Halstead to a condition very similar to the latter variety of duct cancer. The growth consists of tubular spaces heavily lined with epithelium it develops slowly but frequently fungates through the skin and presents as a

localized pedunculated growth which readily bleeds. The axillary glands are usually free from infection and the prognosis is good.

The duration of cancer varies considerably in the different forms. The encephaloid type runs a rapid course and will probably destroy the patient's life in six to twelve months. Duct cancer is very slightly malignant whilst atrophic scirrhous is similarly slow in growth and in both death may be postponed for a considerable period or is often due to some intercurrent malady. Cancer *en cuirasse* is variable in its course being sometimes tolerably rapid and at others chronic; it cannot be cured by operation on account of its early and extensive dissemination. A circumscribed scirrhous tumour is stated to end fatally on an average in two or three years if no operative treatment is undertaken.



FIG 684 — CARCINOMA OF THE LEFT BREAST

The growth is seen at the upper edge of the breast ulcerating through the skin.

Colloid degeneration is not uncommon in carcinomatous growths of the breast and in some is so marked that the title colloid carcinoma has been applied to them (Fig 685). It is difficult at times to recognize the histological structure of such a cancer owing to the degeneration of the epithelial cells.

The Pathological Anatomy of cancer is discussed at p 225.

The Diagnosis of scirrhous from chronic interstitial mastitis and chronic abscess has been already considered. From the adenomata it is easily distinguished. The stony hardness of a scirrhous its incorporation in the breast substance its limited mobility the dimpling of the skin retraction of the nipple and enlargement of the axillary glands are the chief local characteristics to be noted. Non malignant tumours are more elastic to the touch more movable and usually

circumscribed in outline whilst the skin though expanded does not become adherent the nipple is rarely retracted and the axillary glands remain normal. It is often impossible to distinguish a sarcomatous tumour except on microscopic examination a round celled sarcoma closely resembles an acute cancer although it is usually more circumscribed—at any rate in the early stages a *fibro-sarcoma* may sometimes be mistaken for scirrhus but it is more defined in outline does not cause retraction of the nipple or dimpling of the skin and lymphatic enlargement is not constant. A *cysto-adenoma* presents no difficulty in diagnosis if the skin is entire and the cysts prominent but when ulceration has taken place and a fungating bleeding mass protrudes it is not unlike the later stage of an encephaloid cancer or a fungating round-celled sarcoma. It can be distinguished however by the fact that a probe can sometimes be passed under the skin for some distance

between the tumour and the skin and that lymphatic enlargement is rare.

Treatment must be considered under two heads according to whether it is undertaken by operation or by radium.

Operation should be employed in all cases where there seems a reasonable chance of eradicating the disease although certain surgeons are in favour of treating all cases with radium. The contra indications for operation are extensive adhesion to the thoracic walls the presence of visceral deposits and extensive diffusion of a

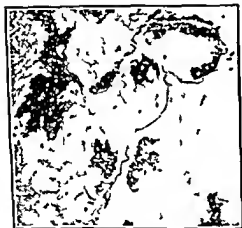


FIG 685 —MICROPHOTOGRAPH OF COLLOID CARCINOMA OF THE BREAST ($\times 82$)

rapidly growing acute cancer in a young subject. Atrophic scirrhus is often left alone in very old people on the plea that the prognosis is so favourable as to render treatment unnecessary if the patient is fairly strong however there is no objection to operation and it certainly seems wise to remove a cancerous focus however chronic it be. Disease of both breasts although rendering the prognosis more grave is *ceteris paribus* no hindrance since both organs have been removed successfully even at one operation. Speaking generally rapidly growing tumours in vigorous patients are very unfavourable cases to deal with whilst slow growth of the tumour and definite limitation of its outline are favourable signs.

In the old days if 5 to 10 per cent of the patients were free from disease it was thought to be as much as any surgeon could reasonably expect. Since we have learnt more of the anatomy of the organ and

of the evolution of the disease more extensive proceedings have been undertaken with a gradual amelioration in the results so that several surgeons have been able to report 50 to 60 per cent of their cases as free from recurrence at the end of three years

The breast is a much more extensive organ than was formerly supposed its lobules extending upwards nearly as high as the clavicle, outwards into the axilla, and for some distance downwards so that removal merely of the prominent part of the gland may leave much behind, and thereby favour recurrence Moreover, the deeper lymphatics pass into the fascia covering the pectoralis major, and so to the axilla hence this muscle should always be removed though some surgeons advocate leaving the clavicular portion It is best to remove also the pectoralis minor muscle, as when this is left a proper dissection of the axilla cannot be undertaken The subsequent movements of the arm are very little interfered with by these procedures Again lymphatics travel along the fibrous bands reaching from the breast tissue to the overlying skin and thus this latter must never be dissected back from over the tumour The nipple should under no circumstances be left behind as it is part of the breast, and all the interlobular lymphatics converge to a plexus round it, and thence pass to the axilla by three or four main branches In every case the axilla should be cleared of its lymphatic contents since deposits in the glands are often found on microscopic examination where no clinical evidence of their presence had been previously noted It is also important to remove the breast and axillary tissues in one piece, so as to avoid division of the lymphatics and possible infection of the wound with their cancerous contents

Operation for Cancer—The patient lies on the back, with the head directed towards the opposite side, and the arm raised and held to a little more than a right angle The field of the operation is protected from the patient's face and the anaesthetist by sterile towels The axilla should be previously shaved and the skin purified The incisions employed vary with the size and position of the tumour, the primary object is to remove the growth together with the whole gland and all its accessible lymphatic connections, the question of being able to close the wound subsequently is secondary As a rule, sufficiently wide undercutting will allow very extensive wounds to be closed but when this is impossible, skin grafting can be adopted and no lengthy convalescence need ensue

In planning the incisions the growth should be taken as the centre, and a circle with a diameter 4 to 5 inches made, it is convenient to prolong the upper and lower portions upwards towards the axilla and downwards towards the epigastrium so as to secure a straight line for the final suture (Fig 686) The upper incision is prolonged towards the axilla, and runs up and curves down towards the insertion of the pectoralis major to the humerus.

The dissection of the axilla is started first in order to avoid an unnecessarily prolonged exposure of the chest wall The skin flaps are undercut and retracted, a transverse incision in the fascia at the level of the insertion of the pectoralis major is made, the cephalic vein

identified and the anterior border of the latissimus dorsi exposed. The upper lower and lateral limits of the axillary dissection are thus defined. The pectoralis major is divided close to its insertion and retracted inwards. The axillary fascia is incised so as to expose the axillary vein and the dissection is then carried upwards and inwards towards the clavicle. The clavicular attachment of the pectoralis major is divided and the insertion of the pectoralis minor severed close to the coracoid by drawing these down the axillary contents are exposed and can be dissected away from the axillary vein together with the lymphatic area running up under the clavicle. Care is taken to identify and preserve the nerve to the latissimus dorsi and the

nerve of Bell which are exposed in the posterior part of the wound. Hot saline packs are placed in the axillary wound.

The lateral skin flap is then undercut, and the whole breast and axillary contents are drawn over towards the middle line the dissection is carried forwards and inwards starting from the outer border of the latissimus dorsi. The inner aspect of this muscle is cleared as well as the axillary surface of the subscapularis. The subscapular nerves are identified and protected and some branches of the subscapular vessels may need ligature. The serratus magnus can then be denuded of the overlying fascia care being taken to secure branches of the intercostals and finally the attachments of the pectoral muscles to the ribs and sternum are divided from below anterior and lateral penetrating branches of the internal mammary vessels being ligatured. The mid line of the sternum is thus reached a portion of the rectus sheath being included in the

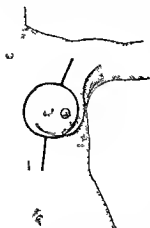


FIG 196. DIAGRAM TO SHOW THE INCISIONS IN THE RADICAL OPERATION FOR CARCINOMA OF THE BREAST (AFTER SAIPSON HANDLEY)

dissection. The breast is then turned back to its original position and the medial skin flap is dissected up across the middle line the advantage of doing this step last being that the vessels have already been secured in the deep dissection. A few strokes with the scalpel then separate the fascia in the sternal mid line and the breast and axillary contents are removed. Great care is taken with hemostasis as there is considerable oozing from such a large raw area. A drain is introduced into the axilla through a stab-wound for twenty four to thirty six hours. The skin flaps are drawn together with tension sutures and the wound closed. In dressing the case it is advisable to place extra pads of wool in the axilla and under the clavicle so that their presence may assist in the prevention of oozing. The arm should be kept at an angle of 45° away from the trunk so as to allow the skin flap to fall against the chest wall this does not interfere with the subsequent free movement of the arm.

Local Recurrence after Operation is always due to incomplete removal of the growth or to infection of the wound with cancer cells during the operation. The recurrence appears either in the neighbourhood of the cicatrix, the most usual situation or in adjacent glands, in the other breast, or in the retrocostal connective tissue.

Treatment with Radium—This method has come into prominence lately, and with a more satisfactory technique holds out a greater

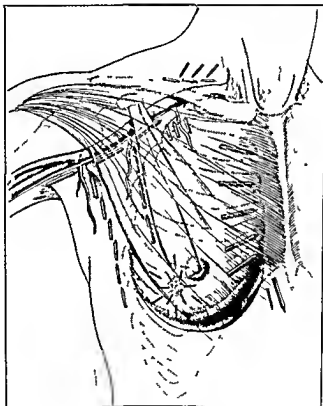


FIG 687 —DIAGRAM TO ILLUSTRATE THE TREATMENT OF CARCINOMA OF THE BREAST WITH RADIUM

promise of cure than previous attempts suggested. Cases in which there is definite involvement of axillary or supraclavicular glands are best suited for this treatment. The technique consists in the use of a large number of needles, with small amounts of radium planted in and around the disease and retained for a long time. The primary growth is intensely radiated, as are the secondary growths, in the lymphatic glands. The possible lines of extension of the growth are also treated, and, inasmuch as the influence of the radium can spread

to areas inaccessible to the scalpel, such as the intercostal lymphatics, a wider area can be treated than is practicable by excision.

The case is prepared as for operation, and the skin purified. The insertion of the radium can be undertaken either under local or general anaesthesia.

The needles are prepared as already explained (p. 306). The area of the primary growth is treated first. Needles containing 1 or 1.3 mg. are inserted into the tumour in the form of two concentric circles, or they can be placed between the growth and the pectoral fascia in parallel lines. Accessory to these, needles are introduced as follows: (1) Needles of 2 mg. into the periphery towards the sternum, and also into the four upper intercostal spaces, (2) needles of 2 mg. into the axilla parallel with the axillary vessels, and needles of 3 mg. towards the axillary apex, (3) a row of needles of 2 mg. just anterior to the mid axillary line, and another similar group along the lateral pectoral border, (4) needles of 2 mg. are inserted through the pectoral muscle into the costo-coracoid membrane, so as to influence the infra clavicular region, and, finally, (5) a series of 3 mg. needles is placed parallel to and above the clavicle, so as to deal with the supraclavicular region (Fig. 687).



FIG. 688.—ADVANCED CARCINOMA OF BREAST AFTER THE REMOVAL OF RADIUM NEEDLES.

In all about thirty-five to forty needles containing about 60 to 90 mg. of radium are employed. If the needles are conical pointed, a small incision has to be made for the introduction of each one, whereas if the needles are trocar pointed no incision is necessary. The threads are arranged in series and knotted. A dressing is placed over the area and strapped firmly in position. The needles are removed on the tenth day, the total

dose being about 14,000 to 21,000 mg. hours. Patients complain of a certain amount of pain and discomfort during the first days, and may require sedatives. It will be understood that each case is treated on its merits, some requiring a larger dose of radium in one area than in another, according to the site of the primary growth and its more obvious lines of extension (Fig. 688). It must also be remembered that damage may be done by the physical pressure of the needles unless due care is exercised, thus in dealing with the left breast, needles introduced too vertically into the intercostal spaces may perforate the pericardium or even the heart.

The patients are usually able to leave the hospital after fourteen days, and should be seen weekly. At the end of a month an opinion can be formed as to the success of the treatment. If signs of activity persist, further treatment is required and this is best undertaken by means of two Columbia paste jackets, one for the front and one

for the back. About 100 mg of radium are distributed over the jacket between two layers of plaster. The front and back are irradiated alternately for twelve hours each for fourteen days. Some surgeons prefer the jacket method of irradiation for the breast with interstitial radiation of the glandular deposits.

Amputation of the breast for *non malignant* conditions is a very different operation from that described for cancer. The incisions usually employed are crescentic and placed obliquely, they need not include much more skin than that indicated by the breadth of the areola. The integument is dissected up from the glandular tissue on either side, and the organ freed from its attachments to the pectoral fascia, the axilla is frequently not opened.

CHAPTER XXXIX

ABDOMINAL SURGERY

General Remarks on Abdominal Operations—No branch of the surgical art has grown so rapidly or attained such importance as that directed to the abdominal contents. Operations directed thereto are now of everyday occurrence and no surgeon hesitates to open the peritoneal cavity whenever it appears necessary even with the object of merely exploring its contents. Success is however entirely dependent on minute and careful attention to detail. The peritoneum properly treated is a good friend to the surgeon it resents however rough handling or prolonged exposure and serious trouble may follow slovenly work jeopardizing the patient's life or even if he live giving rise to such disabilities and discomfort as may impair his usefulness. In no department of operative surgery is rapid and yet minutely careful work so well repaid.

The patient should be *prepared* when circumstances permit by regulating the diet and bowels for some days previously and thoroughly cleansing the teeth and mouth so that the intestinal canal may be as free from organisms as possible. During the previous day the patient is kept quiet perhaps in bed and an effective purgative given *e.g.* 1 ounce of castor oil an enema may be desirable on the morning of the operation to ensure that the lower gut is empty. The abdominal wall is shaved as also the pubes and purified beforehand in the usual way special care being directed to the umbilicus where dirt is very liable to lodge.

No food should be allowed by mouth for three or four hours and immediately before being placed on the table the bladder should be emptied if need be by catheter. If the proceedings are likely to be protracted it is advisable to give a rectal injection of warm saline solution half an hour beforehand.

The patient should be warmly wrapped up and protected from cold no unnecessary exposure being allowed. The operating room should be warm not below 70° F a temperature of 80° F though trying for the surgeon and his helpers is better for the patient. Complete anæsthesia is desirable so as to diminish shock but this should be obtained with as small a dose of anæsthetic as possible. A preliminary injection of morphia and atropin about half an hour before the operation is desirable combined possibly with a small dose of hyoscin. When possible gas and oxygen or spinal anæsthesia should be employed. Intraperitoneal operations are not painless for although the visceral peritoneum is not acutely sensitive yet the parietal layer is as well as that included in the mesenteries and any handling of these structures

especially traction gives rise to pain and necessarily to increased shock. If the patient is very collapsed beforehand as in emergency work e.g. perforation of the stomach it is often advisable to maintain an intravenous saline infusion throughout the operation or a preliminary intravenous saline infusion or a whole blood transfusion may be desirable.

As a general rule the patient lies flat on the table but if the operation involves the pelvic viscera the *Trendelenburg position* is often adopted in which the patient is placed with the head considerably below the rest of the body. All modern operating tables are provided with arrangements for the rapid and easy adoption of this position. Care must be taken to see that the arms are not kept above the head or musculo-spiral paralysis may follow they are best fixed under the patient's buttocks or close to the sides. This position must not be adopted when it is probable that the pelvis is occupied by a fluid inflammatory exudate nor in conditions where obstruction is present as the stomach is then likely to be filled with offensive material which might gravitate into the mouth and suffocate the patient in these cases the stomach should always be well washed out and thoroughly emptied before the anæsthetic is given.

Antiseptics are carefully avoided in intraperitoneal operations after efficient sterilization of the hands of the surgeon and his assistants and of the skin of the patient nothing is employed in the shape of lotion except sterilized salt solution. Instruments are boiled previously and counted. Swabs each with a long tape are best done up in packets of a dozen wrapped in gauze it is thus easy to keep account of the number employed. Gauze strips for packing abdominal cloths etc. are dealt with in the same way a careful record of the number employed must be made before and after operation.

Parietal Incision—In planning the incision for any abdominal operation three desiderata have to be kept in view. (1) Suitable access should be provided to the part to be explored naturally the middle line gives the best approach in the majority of cases where a general exploration is desirable and in many other conditions it is most useful. But when dealing with such structures as the appendix or gall bladder an incision placed laterally is usually more convenient. It is always well to remember that incisions should not be placed too near to the bony or cartilaginous boundaries of the abdominal wall. (ii) It must be so placed as to ensure an *effective blood supply* and thereby avoid as far as possible the risk of defective union or of post-operative hernia. Naturally the middle line from this point of view is not desirable and the linear semilunaris is even worse. Particularly is this the case when the linea alba has been stretched and the recti muscles separated one from the other. Perhaps the best incisions from this point of view are those which pass through muscular fibres splitting and separating but not dividing them. McBurney's incision for the removal of a quiescent appendix is of this nature it gives a sufficient approach when there are no adhesions and when the appendix is not displaced. A paramedian incision with displacement outwards of the rectus is also useful taking the place of the old middle-line incision but many

surgeons prefer to detach the rectus from the linea transversæ and displace it outwards opening the peritoneal cavity through the posterior segment of the sheath (ii) A point to which considerable attention has been given in recent years is the *nerve supply* of the abdominal wall. As far as possible the incisions should be planned so as to avoid division of the motor nerves especially those going to the rectus abdominis inasmuch as paralysis of this muscle may result in considerable discomfort and loss of tone of the abdominal wall may follow. From this point of view an incision through the linea semilunaris is one of the worst that could be devised and the paramedian incision with displacement of the rectus outwards the best.

Some surgeons have recommended a *transverse* incision of the abdominal wall especially in dealing with pelvic lesions the chief difficulty lies in gaining effective union of the divided ends of the rectus muscles. To prevent their retraction the fibres must be carefully stitched with mattress sutures to the anterior wall of the sheath before being divided on the whole this method of approach has not been much employed although it leaves beautiful scars.

The muscles and aponeuroses should always be cleanly divided and it is wise to see that bleeding is stopped before opening the peritoneum this membrane can usually be picked up by dissecting forceps and opened with scissors or a knife air rushes into the cavity and it is easy to secure the margins with Spencer Wells or other forceps. Holding these well up the incision can be prolonged up or down as far as may be considered necessary.

The intestines must be carefully guarded during the intraperitoneal portion of the operation as if they are unduly exposed to the air the endothelial lining is quickly shed adhesions may then form subsequently and bacterial invasion from the gut is favoured. If they have to be withdrawn from the abdomen they should be wrapped in cloths wrung out of warm salt solution and it is the assistant's duty either to replace these from time to time by warm cloths or better to keep them moist and warm by pouring fresh salt solution over them no unnecessary handling of intestine is permitted. If any infective focus is to be opened, or the intestine incised the surrounding parts must be carefully protected from infection by walling off the area of operation this is effected by surrounding it with abdominal cloths of suitable size and material or strips of sterilized white gauze wrung out of warm salt solution or by placing them in directions where pus or other fluid might gravitate. A record of these must be kept and it is wise to have tapes attached to each one and never to cut any of them into smaller pieces. It is undesirable to use dry gauze for this purpose as it is likely to stick to the intestine and its removal may disturb the endothelial covering.

Closure of the Wound—A careful toilette of the peritoneum must be undertaken before the abdomen is closed. All bleeding is stopped and blood-clot removed swabs are counted and if thought necessary the site of operation cleansed with sterilized salt solution at a temperature of about 103° F. Many different methods of closing the parietal incision have been adopted but perhaps the best consists in first

securing the peritoneum by a continuous catgut stitch, then the muscular coats are approximated by deep interrupted stitches, usually of thicker catgut, which remain buried, and, finally, the skin is united by means of a continuous suture of silk worm gut or silk which is subsequently removed, or by interrupted silk worm gut stitches. In some parts it is difficult to secure the peritoneum separately, and then it is well to include everything except the skin by deep interrupted sutures, and some surgeons even include the skin in the grasp of these deep stitches.

Drainage is not usually called for in abdominal operations. If the surgeon is careful in his manipulations, and avoids measures which are liable to lead to subsequent oozing, the peritoneum may be closed with safety. When adhesions likely to bleed have been divided, or raw surfaces left such as occur after enucleating a parovarian cyst from the broad ligament, some means should be provided whereby any considerable effusion of fluid can escape, and this can often be best effected by the use of a rubber tube for twenty-four hours, in which a strip of aseptic gauze is placed to act as a wick, and along which, by capillary action, the effusion finds its way into the general dry dressing placed over the wound, or a cigarette drain may be used, i. e. a strip of gauze wrapped round with gutta serena tissue, in order to facilitate its removal.

On the other hand, when an infected focus has been opened and needs to be drained, e. g. an acute appendix abscess, it is sometimes necessary to protect surrounding parts from the spread of infection, and this is best accomplished by the use of a rubber drainage-tube, around which sterile gauze is packed in such a way as to induce the formation of adhesions.

After-Treatment.—After the completion of the operation, the patient

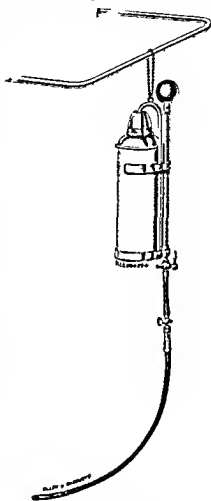


FIG 632.—APPARATUS FOR ADMINISTRATION OF SALINE SOLUTION BY THE RECTUM.

The flask to hold the fluid is supported by a bar fixed to the bedpost and the rate of flow is regulated by the tap placed just below the flask and above the glass dropper.

and its occurrence is not unfrequently indicated by a slight but persistent rise of temperature (say to 100° every night) associated perhaps with an increased rate of pulse. The external wound may apparently heal perfectly and then ten or twelve days after the operation the cicatrix yields and a quantity of pus may escape. Under these circumstances efficient drainage should be arranged and if need be the exposed stitches must be removed. Of course this process weakens the abdominal wall and extra precautions must be taken to prevent the formation of a ventral hernia.

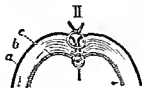


FIG. 692.—CZERNY-LEMBERT SUTURE

- I. Stitch securing divided mucous membrane II. ordinary Lembert suture for the serous coats a serosa b muscularis c mucosa.

Intestinal Sutures—The interior of the bowel is occupied by material which as long as it remains in its proper place is innocuous enough but should it find its way into the peritoneal cavity an acute and often fatal peritonitis is almost certain to follow. Hence every union made by the surgeon must be air and water tight and capable of accommodating itself to varying degrees of intra-intestinal pressure. It is also essential that on its peritoneal aspect the line of union should present nothing but

serous membrane as otherwise adhesions are likely to form and the comfortable action of the bowel may be subsequently impaired. Special forms of stitches have therefore been adopted the more important of which are described below.

Lembert's Suture originally proposed at the end of the eighteenth century has for its object the bringing of surfaces of peritoneum together without encroaching on the mucous membrane any stitch which involves the whole thickness of the wall is liable to be followed by leakage of the intestinal contents and possibly by peritonitis. The needle is passed at right angles to the axis of the wound through a small fold of the serous and muscular coats going down to the sub-mucosa each fold is placed about $\frac{1}{4}$ inch from the margin of the incision (Fig. 690).



FIG. 693.—HALSTEAD'S MATTRESS SUTURE.

On drawing up and tightening the stitch the margins of the wound are tucked in (Fig. 691) and only the serous coats brought into apposition. A series of similar stitches are inserted along the whole extent of the wound numbering about ten or twelve to the inch or it may be carried on as a continuous stitch. In closing a longitudinal incision in this way a groove will be formed at either end which must be obliterated by two or three extra sutures. For a small puncture the same type of stitch is utilized but it may be introduced

circularly around the opening like a purse-string, and by tightening it the margins of the aperture are turned in and buried.

The *Czerny Lembert Suture* is very similar in its nature, but consists of two rows the first has for its object the closure of the wound in the mucous membrane (Fig 692) and in a longitudinal wound this may be of the continuous type, the second row consists of the ordinary Lembert stitches continued or interrupted according to the requirements of the case (Fig 692). By this means the knots of the first series of sutures are covered over and buried by the second row. When carefully introduced these stitches not only serve to approximate the divided walls of the intestine, but also are valuable hæmostatic agents especially if inserted continuously.

Halstead's Mattress Suture (Fig 693) is a very useful one, and constantly utilized. It consists practically of a double Lembert, a loop being thus formed at one end, whilst the knot is tied at the other. It is introduced with exactly the same precautions as the original Lembert.



FIG 694.—WOLFER'S SUTURE

- I Stitch through serous and muscular coat applied and tied from within II stitch uniting divided mucous membrane over the former so as to cover it in *a* serosa *b* muscularis *c* mucosa

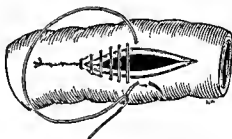


FIG 695.—CUSHING'S RIGHT ANGLED SUTURE FOR UNITING THE SERO-MUSCULAR COATS OF THE STOMACH OR INTESTINE

For the sake of clearness the preliminary row of stitches through the mucous membrane is omitted in this diagram.

Occasionally it happens that two segments of bowel have to be stitched together from inside since the surgeon cannot reach the outer coats owing to this portion being fixed. Thus, in an exploratory gastrotomy it may be necessary to stitch up the posterior wall of the stomach after having opened it from the front. The stitches must then be inserted by what is known as *Wolfer's Method* (Fig 694). They are first passed through the serous and muscular coats on either side (I), the knots being tied on the inner aspect, i.e. towards the lumen of the open viscus. The mucous membrane is then secured by a second row of stitches (II), so as to cover over the first series of knots. In many forms of intestinal anastomosis this plan has also to be employed, as soon as possible however, one changes to the *Czerny Lembert method*.

Cushing's Right-Angled Suture (Fig 695) is a most useful one when surfaces of some extent have to be approximated by a continuous stitch. The suture is introduced at one end of the incision and tied

according to the usual Lemberg method and then it is carried on as a continuous Lemberg suture except that the needle is introduced *parallel* to the margins of the wound and at a distance of about $\frac{1}{2}$ inch from it instead of at right angles to it. The edges are thereby tucked in very neatly. Of course the mucous membrane is first dealt with separately by some form of continuous suture. It may be employed very advantageously in gastro-enterostomy or any similar procedure.

Injuries of the Abdominal Wall

These may be divided into three main classes—contusions non-penetrating and penetrating wounds, but of course the most important point about them is as to whether or not visceral complications are present.

Simple Contusions of the abdominal parietes differ but little from those of any other region of the body. Any form of lesion from a slight bruise to a well marked hæmatoma or an extensive muscular laceration may be included in this category. The rectus is the muscle most often involved and its laceration may result not only from injury, but also as a consequence of sudden and forcible contractions *e.g.* in tetanus. The hæmorrhage may be limited by the lineæ transversæ if it only involves the anterior aspect but may diffuse itself widely through the sheath if the back of the muscle is torn. All abdominal hæmatomata are very liable to suppurate the abscess either pointing locally or burrowing widely between the muscular planes and coming to the surface at some weak spot *e.g.* Petit's triangle or the external abdominal ring. The pus is usually redolent of the *B. coli* suggesting that the organism found its way into the extravasated blood from some damaged or bruised coil of intestine in the neighbourhood. Occasionally the parietal peritoneum is torn causing shock and intra-peritoneal extravasation of blood. In almost all abdominal contusions shock is an important early symptom but in the absence of visceral lesions it is neither severe nor prolonged. Muscular lesions are sometimes liable to determine the occurrence of hernia at a later date and hence must be carefully treated. In the rectus spasmodic contraction of one of the segments may give rise to what is known as a phantom tumour usually found in hysterical females and disappearing under anaesthesia.

Treatment consists in keeping the patient in bed until the tenderness and pain have disappeared. Shock is dealt with in the usual way and fomentations or a firm compress of dry hot wool will give much comforting support. Rupture of the rectus muscles necessitates the adoption of the sitting position with the knees flexed over pillows at a later date support as by strapping or a well fitting abdominal belt will be required.

Non-Penetrating Wounds of the Abdominal Wall have no special significance and if uncomplicated by visceral lesions are treated on general principles. If the epigastric artery is divided extensive extravasation is likely to ensue the wound must then be enlarged and the bleeding points secured. If the abdominal muscles are widely

divided, steps should be taken, after thorough purification, to draw together the severed muscular or aponeurotic fibres by deep stitches, so as to diminish the tendency to a ventral hernia.

Penetrating Wounds of the Abdominal Wall may occur with or without injury or protrusion of the abdominal viscera. In all cases there is a certain amount of hæmorrhage, greater or less according to the size of the vessels divided, and of shock, which latter is very marked when the viscera are injured, whilst mere protrusion without injury may cause but little effect. Thus, cases are on record in which a patient has walked to the surgeon for treatment, supporting some coils of intestine in his hands. The protruded viscera, usually small intestine or omentum, are often large in amount compared with the size of the opening, causing them to be more or less congested or even strangled. Necessarily, in all cases the great danger is that of diffuse septic peritonitis, caused either by rupture of the intestine or by infection from without.

Treatment.—The external wound is thoroughly cleansed, the skin margins and damaged muscular tissues are excised, and protruding viscera are carefully examined. If omentum has escaped, it is wise to ligature and remove it, whether it is injured or not. Intestine should be gently washed with warm saline solution and replaced, if slightly bruised, it may be returned, but the external wound should not be entirely closed, and a cigarette gauze drain is inserted, so that if bacillary invasion or fæcal extravasation occurs subsequently, a ready exit is provided. Small incisions or punctures must be infolded and sutured, but when small intestine is seriously damaged, enterectomy should be undertaken if the patient's general condition is sufficiently good, otherwise it must be fixed to the abdominal wall, and a temporary artificial anus provided. With the large intestine this latter course is required more often, and especially in cases where the bowel is loaded with fæces, the gut must then be fixed in the wound as in colostomy and the defect dealt with at a subsequent period.

In cases where it is not certain whether the peritoneum has been implicated, the surgeon should always enlarge the wound so as to make sure, and if the serous membrane has been involved, he should carry his investigations still further, and ascertain whether any damage has been done to the viscera.

The external wound must (except in the cases mentioned above) be carefully closed with sutures so as to minimize the risk of a subsequent ventral hernia.

Visceral Complications are likely to be associated with any injury to the abdominal wall, and may transform it into a lesion of the gravest import. The liability to visceral injuries varies with the character of the violence, and with the condition of the abdominal wall and of the subjacent viscera. If the blow is slight, the effects are probably not serious, and the patient merely suffers from a localized contusion with some amount of shock. If the blow is expected, and the muscles are rigid, but little harm may follow, even when the violence is great, but when the abdominal wall is relaxed and the blow unexpected, a slight injury may do much mischief. Hollow viscera, *e.g.* the stomach,

intestine or bladder may be torn and when distended they are more liable to such an accident. Solid viscera such as the liver spleen or kidneys may be bruised or torn and grave hæmorrhage result therefrom a soft fatty condition of the organs especially of the liver predisposes to such a lesion. Displacement of organs sometimes occurs and it must not be forgotten that any sudden sharp concussion especially if directed to the epigastrium is liable to be followed by severe shock from irritation of the subjacent solar plexus and life itself may be destroyed in this way by syncope without the appearance of any evident lesion. The omenta mesenteries and peritoneal ligaments may also be torn and give rise to hæmorrhage or to the formation of apertures or bands which can determine obstructive phenomena at a later date.

The clinical history of these injuries will be described under the various organs and only a few general statements need be made here. It is obvious that a serious responsibility rests upon the medical attendant in any case of abdominal injury and that the gravest results may follow a mistaken conclusion as to the nature of the lesion or a hesitant policy in undertaking operation. In a large proportion of cases abdominal injuries even including rupture of intestine are amenable to treatment by operation if only it is performed sufficiently early when however it is delayed until the gut is paralyzed and peritonitis well established death is almost certain to ensue whether the abdomen is opened or not. Unfortunately no absolute rules can be laid down as to when operation is necessary but the surgeon should remember that exploration in a doubtful case probably does far less harm than waiting until the diagnosis is made certain by an outbreak of diffuse inflammation providing always that the patient is not so profoundly collapsed as to contra indicate all interference.

Cases of serious abdominal injury group themselves into three sets (1) Where in addition to a localized lesion of the parietes there is severe shock due to contusion of viscera but with no justification for laparotomy (2) where there is serious intraperitoneal hæmorrhage as from a ruptured liver or spleen or a tear of the mesentery and (3) where a hollow viscus is opened and peritonitis is at once lighted up.

Shock is almost always well marked in abdominal lesions but unless there is a serious wound of some viscus it usually passes off in less than twenty four hours if the patient is left quietly in bed. *Intraperitoneal hæmorrhage* causes various symptoms according to its amount and site of origin in addition to the initial shock the general signs characteristic of this condition show themselves. Dulness may be noted in one or both flanks according to the situation of the lesion being influenced by the attachment of the mesentery and the position of the patient whether lying or able to sit or stand up thus blood from the liver may gravitate into and for a time be limited to the right lumbar region and iliac fossa without reaching the pelvic cavity blood from the spleen will pass freely down into the pelvis along the left side of the mesentery producing dulness in the left loin and not in the right. It must be remembered however that a large quantity of blood may escape into the peritoneal cavity without the production of any recognizable area of dulness it is then lodged under the costal arch or amongst the intestines or in

the pelvis. When the bleeding is less severe the patient complains of a severe tearing pain, becomes pallid and anæmic, but may recover, and the blood be absorbed, not unfrequently the temperature rises after the initial shock has passed, and remains up for some days. The onset of *peritonitis* is indicated by persistence of the collapse, and vomiting or hiccough, whilst the abdominal wall is held rigidly steady, and the breathing becomes thoracic, probably some fixed spot of maximum tenderness will be noted, especially when the intestine is injured, abdominal distension comes on later.

Treatment—The patient having been put to bed, and the initial shock combated in the usual way, a most careful examination of the patient and his abdomen is instituted. Conditions which indicate immediate operation are (a) the signs of intraperitoneal hæmorrhage, (b) blood stained vomiting, indicating a rupture of the stomach, (c) a fixed and rigid abdominal wall coming on quickly after an injury, with severe pain and localized tenderness, suggesting a rupture of the intestine, and (d) the phenomena due to a ruptured bladder. Under such circumstances no delay is justifiable, and, even if severe shock is present, operation should be commenced, unless death is evidently imminent. A large intravenous injection of hot saline solution or a blood transfusion will usually rally the patient sufficiently to warrant the surgeon in proceeding.

If however well marked shock is present, with perhaps localized pain, but with no absolute evidence of visceral lesions, *expectant* treatment should be adopted. The patient is kept warm in bed, perhaps a little opium is administered to allay pain and restlessness and to check peristalsis, but as little as possible should be given, since symptoms are so completely masked thereby. If there is any vomiting, rectal alimentation should be employed after the lower bowel has been washed out. If the manifestations of intraperitoneal hæmorrhage subsequently make themselves evident, or if at the end of not more than twenty four hours the patient is still, more or less, in a condition of collapse, and especially if he complains of a fixed tender spot with a rigidly contracted abdominal wall over it, or if vomiting or hiccough has supervened, then operation can still be undertaken with some prospect of success.

Affections of the Umbilicus.

The various forms of umbilical hernia are described elsewhere.

Inflammation and Ulceration, perhaps running on to eczema, may arise from want of cleanliness after separation of the cord. Tetanus neonatorum probably owes its origin to this source, as also the erysipelas of infants, both of which diseases are exceedingly fatal, the latter being often accompanied by sloughing of the neighbouring abdominal parietes. The eczematous condition merely requires cleanliness, and the application either of an antiseptic dusting powder or of some simple ointment. In adults inflammation occasionally results from the accumulation of dirt in the umbilical fossa, which may even at times constitute a *calculus*, giving rise to suppuration and ulceration.

In hepatic cirrhosis with marked portal obstruction varicose veins occur around the umbilicus constituting the stellate caput medusæ.

Occasionally a Polypoid Excrescence is met with growing from the umbilicus and is probably derived from the remains of the umbilical vesicle. On microscopic examination it is found to consist of a number of tubular glands held together by connective tissue. All that is needed is to ligature the base and cut it away.

Cancer of the umbilicus may be primary occurring either as a squamous epithelioma starting in the skin as a result of prolonged irritation or as a columnar carcinoma arising in some fetal relic. More frequently it is secondary to some deep abdominal focus such as cancer of the stomach, ovary or the breast.

Umbilical Fistulæ not unfrequently occur and may be congenital or acquired. Three varieties are described.

(a) A *Facial Fistula* of congenital origin arises from non-closure of the vitello-intestinal duct and opens into the intestine either directly or by means of a passage of greater or less length which corresponds to Meckel's diverticulum and is connected with the lower part of the ileum. Sometimes this passage is closed at the intestinal end and then only discharges mucus. Acquired cases are usually due to perforation of the bowel following strangulation of an umbilical hernia or to tuberculous peritonitis.

(b) A *Congenital Urinary Fistula* is due to non-closure of the urachus occasionally merely a sinus persists leading towards the bladder but not opening into it. It may be dealt with by excision of the mucous membrane its destruction by the galvano-cautery or by freshening the edges and subsequent suture.

(c) A *Biliary Fistula* sometimes forms at the umbilicus resulting from an abscess connected with the gall bladder.

Affections of the Peritoneum.

Peritonitis arises from many different conditions and presents many diverse manifestations. It may be acute or chronic in its course localized or diffuse in its distribution and protective or rapidly destructive in its results.

Ætiology—Peritonitis is almost invariably due to the action of micro-organisms and the symptoms largely depend on the toxæmia determined thereby. The bacteria light up an inflammatory reaction characterized by effusion of varying type. In the mildest forms it is usually abundant and localized. In the severer types it is generalized and in the worst cases death may ensue from toxæmia before there has been time for the development of marked anatomical changes.

1. Infection may start from any part of the intestinal canal from stomach to rectum. It may be due to traumatic or pathological rupture or perforation, to the extension outwards of ulcers, to the impaction of foreign bodies or the damaging influence of interference with the blood-supply as in strangulation volvulus etc. The vermiform appendix is the commonest site of onset of this group of cases. The *Streptococcus pyogenes* and *B. coli* are the organisms most frequently

present but some of the other inhabitants of the intestine, especially those that are anaerobic are occasionally causative. On the whole the gastric contents are less noxious than those of the intestine, and the fluid contents of the small gut are more liable to be diffused, and therefore do more harm than the more solid faeces in the large

2 A somewhat similar type of origin causes *puerperal peritonitis* the organisms (usually streptococci, but of any pyogenic form) extending from the uterus through the lymphatics of the broad ligament, etc., to the peritoneum it is therefore possible for the mischief to limit itself to the pelvic viscera

3 Infection may occur from without, as in perforating wounds, operations, etc. any of the ordinary pyogenic organisms being responsible but especially the streptococcus. The question of infection depends largely on whether or not the peritoneum is bruised, rough handling and prolonged exposure are only too likely to destroy the surface endothelium and diminish its resisting powers whilst the same conditions check the power of absorbing fluids, and hence permit of bacterial growth

4 Peritonitis may be due to the *gonococcus*, and then has usually spread up the Fallopian tube, to the *pneumococcus*, and possibly to the organism of *acute rheumatism*, then, perhaps, starting in the appendix.

5 The *B. tuberculosis* is responsible for the development of acute or chronic tuberculous peritonitis

6 Simple chronic peritonitis of a protective character arises when any irritative lesion of a viscus slowly approaches the peritoneal surface. Adhesions of various types may result from this reaction, and grave developments (obstruction, strangulation, etc.) may follow at a later date

7 A group of cases occurs in which the cause is mechanical or chemical, e.g. extravasation of bile from a ruptured gall bladder, or the irritation produced by torsion of a wandering spleen, or an ovarian cyst, or even of the omentum. Severe reaction follows such a lesion, but it is possible that the focus may be shut off from the general cavity by plastic adhesions, and be thereby encapsuled or absorbed, or the inflammation may extend to neighbouring coils of intestine, and when once these become paralyzed bacterial invasion is almost certain to follow

Varieties.—1 **Acute Diffuse Peritonitis** results from infection of the peritoneal cavity with a large dose of infective material (as by rupture of the stomach or intestine), or by the introduction of a small dose of virulent organisms when the resisting powers are low

Pathological Anatomy.—The peritoneal surface becomes congested and a little sticky, and its shiny appearance is lost (as a result of the proliferation of the endothelial cells and a commencing oedema of the subserous connective tissues), this change is most advanced in the neighbourhood of the site of infection, but rapidly spreads, and in the gravest forms of peritoneal toxæmia, where death takes place under twenty-four hours, there is but little other evidence of the disease. In the great majority of cases, however, effusion occurs, sometimes the fibrinous element is most marked the intestines being matted together, and the fibrin thickest along the lines of contact of adjacent coils, sometimes there is an abundant serous exudate, but more fre-

quently it is sero-purulent or consists simply of pus which may gravitate to the loins and pelvis or travel upwards under the diaphragm or be shut up in pockets by the development of adhesions. The effusion is intensely infective and any wounds caused during the operation or in post mortem examination of such a case are likely to be followed by severe cellulitis or even septicæmia. Gas may be present resulting either from the laying open of an air-containing viscus or from the presence of a gas producing organism.

The intestinal walls become paralyzed as a direct result of the action of toxins upon the contained nervous plexuses and in consequence the contents of the gut stagnate and undergo decomposition. The omentum becomes congested and infiltrated with effusion or even pus it may occasionally however form a barrier across the abdomen shutting off the lower from the upper part limiting the mischief to some particular section.

The toxins developed in the exudate are absorbed by the peritoneum and whilst causing a generalized toxæmia of varying severity they may also determine a well marked subperitoneal œdema. The rapidity of absorption is very considerable especially from the under surface of the diaphragm where the lymphatics are practically continuous with the peritoneal cavity and quickly carry toxins and bacteria to the mediastinal glands. The upper half of the abdomen is therefore a less favourable site for peritonitic trouble than the lower and all available means such as position drainage etc. must be employed to limit or prevent the extension of the trouble in this direction.

Symptoms—The onset varies somewhat with the cause of the affection but when due to traumatic infection from without the symptoms usually commence with abdominal pain and rigidity followed by distension together with flatulence and vomiting. The pain may be localized at first to some particular region or is referred to the umbilicus soon however it becomes diffuse and is associated with exquisite tenderness and great distension. In a typical advanced case the phenomena are very characteristic. The patient lies on his back with the knees drawn up partly to relax the abdominal muscles partly to prevent the bedclothes touching the body. The abdomen is distended hard and extremely tender it is at first generally tympanitic but later on if effusion should become marked dullness may be noted in the flanks although this is not a common feature. The pulse is quick hard and wiry in the early stages though later it becomes weak rapid and compressible. The respirations are quick shallow and thoracic in character. The temperature perhaps raised at first as a result of the causative lesion sometimes becomes subnormal from toxæmia before the end is reached. Vomiting is usually a prominent symptom associated perhaps with luccough to commence with the contents of the stomach alone are expelled but later on they may be mixed with bile or with the decomposing contents of the upper coils of intestine. Though very constant and troublesome it is much less distressing than that which arises from intestinal obstruction and owing to the pain induced by any sudden contraction of the abdominal muscles the patient ejects the vomit with but little force. Constipa

tion and the absolute arrest of flatus are almost always present in peritonitis, owing to the cessation of peristalsis induced by the inflammation, and hence meteorism is a marked symptom. On auscultation the peritoneal abdomen is absolutely silent. As the case progresses the patient's strength rapidly diminishes, his face becomes pinched and drawn (*facies Hippocratica*), the extremities are cold, the temperature is usually subnormal, and death results from collapse and toxæmia.

When due to sudden perforation of the bowel, the onset of the symptoms is associated with profound shock, and the course is very rapid if the opening is large, and the intestinal contents early extravasated. Vomiting, too, is usually more marked than when due to other causes. If, however, the perforation is small the immediate shock is less and the symptoms progress more gradually.

Treatment.—In the early stages if the diagnosis is in doubt, or the desirability of operation is in question, the patient is kept quietly in bed, and preferably in what is known as *Fowler's position* (Fig. 697), i.e. with the head and trunk raised from the horizontal plane about 30° or 40°, so as to determine the flow of fluid exudate down towards the pelvis rather than backwards into the kidney pouches, whence it may spread up to the dangerous subdiaphragmatic area. No food is administered by the mouth, and no purgative given, the lower bowel may be emptied by enema, and subsequently saline injections administered to relieve thirst. Morphia and opium are used with the utmost caution as long as the diagnosis is uncertain, for fear of masking symptoms. By determining a cessation of vomiting and a false sense of comfort, unjustified hopes may be encouraged and delay in operation result, at the same time they may be useful in localizing the trouble and allowing adhesions to form. Whilst the patient is being prepared for operation and the necessary arrangements are being made, a moderate dose of morphia may save him much suffering and help to conserve his powers.

The actual scope and particular features of the operation vary naturally with the many causes that may have been operative in determining the outbreak of the condition, and these will be suitably referred to afterwards. It is only possible here to deal with the general features. The incision is generally median or paramedian in type, and the lower half of the abdomen is opened rather than the upper, unless the latter is distinctly indicated. The objects of the operation are threefold: (1) To find and deal with the cause of the affection, such as a perforation which needs to be closed, or a perforated or gangrenous appendix which must be removed. (2) To cleanse the peritoneum and remove the effusion, and for this the majority of surgeons at the present time rely on simple mopping up of the exudate and perhaps washing away escaped debris of food, as in a perforated gastric ulcer. The surgeon must make certain that there is no retained collection of exudate in Douglas's pouch or in the right kidney fossa after a perforated duodenal ulcer, if present, the collection must be carefully mopped away. The peritoneum has a great power not only of absorbing fluid, but also of destroying bacteria, and hence, if the primary focus of trouble is satisfactorily removed or dealt with, may be largely left to defend itself.

(3) At the same time *drainage* is necessary in many cases where a collection of fluid has formed in the pelvis, this may be effected by the

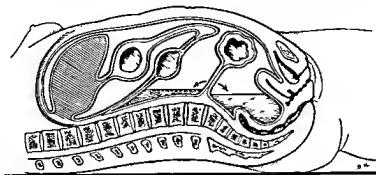


FIG. 696.

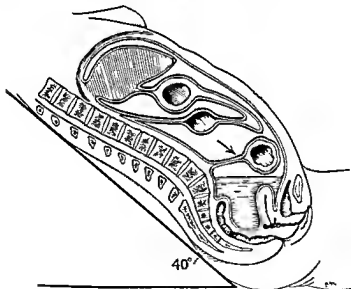


FIG. 697

FIGS 696 AND 697.—DIAGRAMMATIC MESIAL SECTION OF FEMALE ABDOMEN TO REPRESENT THE VALUE OF FOWLER'S POSITION IN THE TREATMENT OF INTRA-ABDOMINAL INFLAMMATORY EFFUSIONS

In Fig 696 the patient is horizontal and it is obvious that an inflamed appendix lying over the brim of the pelvis will cause effusion which drains in two directions upwards towards the liver and diaphragm and downwards to the pelvis. In Fig 697 the body is in Fowler's position and the resulting effusion will collect in the pelvis.

use of rubber tubes with or without gauze wicks or of a cigarette drain. It is probably wise to change the tube for a smaller one after forty-eight

hours, which in turn is followed by a strip of rubber glove as soon as the discharge diminishes sufficiently. The abdominal wall is, of course, only partially closed after these proceedings. Experience however, has shown that the peritoneum has considerable antiseptic and defensive powers and that where the exudate is merely sero-purulent drainage may often be omitted, granted that the case is an early one and that the local causative focus is efficiently treated.

When intestinal distension is very great, so that it may be difficult to reach the cause of the trouble or to return the extruded viscera, it may be advisable to tap a coil of small intestine and empty the contents, or to stitch in a rubber tube and allow the bowel subsequently to empty itself dealing with the fistula so produced at a later date. The reduction of the distension is an essential element if a successful issue is to follow, but undue manipulation must be avoided. If the bowel is merely tapped and at once closed, it may be advisable to follow the plan suggested by McCosh of injecting several ounces of a saturated solution of Epsom salts before closing the abdomen. With the same end in view the hypodermic administration of pituitrin or eserine or large abdominal fomentations, may be employed after the operation with the idea of stimulating the unstriated muscle fibres of the intestinal wall.

As soon as the patient has recovered from the anæsthetic, he should be raised from the recumbent to the sitting posture (*Fowler's position*), with a view to permitting the fluid effusion to gravitate into the pelvis. Continuous infusion of salt solution into the rectum (*proctoclysis*) or subcutaneous tissues should also be employed in order to dilute the toxins and facilitate their elimination. Improvement in the condition of the patient shows itself almost at once by a fall of temperature and of pulse the vomiting ceases or becomes less urgent, pain and tenderness decrease, and the patient looks and feels better. On the second day the bowels are likely to become distended with flatus, and it is necessary to obtain relief, this is best effected by a turpentine enema in the first place followed by a dose of castor oil or of sulphate of soda, or repeated small doses of calomel. As soon as the bowels have acted well, the urgency of the symptoms diminishes and it is probable that the patient will recover.

The American school of surgeons, led by Crile and Oschner, however, recommend a quite different method of after treatment, and equally good results follow. The stomach is washed out before operation and nitrous oxide anæsthesia, followed by local infiltration analgesia, is alone employed. Adequate drainage of the peritoneal cavity is provided, and the patient put back to bed in Fowler's position. Large fomentations are placed over the abdomen, reaching well down to the sides and continuous drip administration *per rectum* of 5 per cent saline with 5 per cent glucose is continued for as long as it can be tolerated. Large quantities of normal isotonic saline are given hypodermically till the time of danger is passed (2,500 to 3,000 c.c. per diem), and the patient is placed fully under the influence of morphia till the respiration falls to 10 to 14 per minute, this is maintained until the patient is out of danger, but not in streptococcal cases.

2. **Acute Localized Peritonitis** usually arises in connection with some

limited lesion of the abdominal contents which is of such a nature as to permit of the general peritoneal cavity being shut off by adhesions the process being thereby localized. It is frequently followed by suppuration the abscess being thus intraperitoneal although not involving the general peritoneal cavity. The abscesses arising in connection with appendicitis or pelvic peritonitis are not uncommonly of this nature. They may burst through the barrier of adhesions and thus light up a diffuse inflammation of the peritoneal sac or they may burrow to the surface and point externally or open into one of the hollow viscera.

The Symptoms complained of are deep pain and tenderness more or less localized to the affected area together with fever vomiting and constipation. At first no swelling or tumour is to be made out but a feeling of resistance may be noticed in the abdominal wall which is held tense and rigid as if guarding some focal point of mischief. As the effusion increases in amount a tumour dull or tympanitic on percussion may become evident it is mainly due to a matting together of the intestines and omentum but is often associated with a variable amount of effusion if however it is placed deeply the dullness may be absent owing to the fixation of one or more coils of intestine in front of the inflammatory focus. If an abscess forms and travels towards the surface the abdominal wall becomes infiltrated red and cedematous the component tissues being brawny to the touch and cutting like bacon. Finally a fluctuating area presents itself in the midst of this indurated mass and the abscess either discharges itself or is opened. The pus contained therein is often offensive owing to the presence of the *B. coli*. Of course this process is attended with considerable increase in the pain and constitutional disturbance. If the cavity is opened aseptically and drained it rapidly contracts and a cure is accomplished although intraperitoneal adhesions may persist and lead to subsequent trouble from hampering the intestinal movements. The determination as to the existence or not of suppuration is by no means easy and a blood-count perhaps repeated more than once is often of the greatest value.

Treatment.—In these cases resolution can sometimes be obtained by keeping the patient absolutely quiet and on a low diet with perhaps a little morphia and by applying timentations locally whilst the lower bowel is emptied by an enema. Such a course must however not be persisted in for too long when suppuration is likely to have occurred for fear of the inflammation spreading to the general peritoneal cavity or of the abscess bursting into it. An early exploratory laparotomy is advisable under such circumstances. The line of treatment marked out for appendicitis is that which should always be followed.

3. **Simple Chronic Peritonitis** in itself rarely requires surgical attention since it is to be looked on rather as a protective than as a destructive process. It is characterized by *infiltration and thickening* of the peritoneum whereby the intestinal wall is strengthened and bacterial invasion hindered. It is *localized or diffuse* in character and arises as the result of some pre-existing inflammation. In the more diffuse forms the intestines may be hopelessly matted together or the omentum

rolled up and contracted into a rounded cord like mass lying transversely across the upper part of the abdomen chronic obstruction is almost certain to arise sooner or later from this condition

More frequently it is the consequence of some localized injury or inflammation In the former plastic lymph is deposited over any breach of continuity of the serous membrane and to this the omentum or intestine becomes adherent the under surface of a laparotomy wound is not unfrequently affected in this way Localized areas of inflammation are similarly liable to originate adhesions which are thus found in connection with gastric ulcers an inflamed vermiform appendix enlarged mesenteric glands or a pyosalpinx Under favouring circumstances many such adhesions are absorbed in the early stages but if they persist they are modified by the intestinal movements and are likely to become lengthened and rounded thus originating the bands and cord like structures so often the causes of acute obstruction The omentum is frequently involved in this process and thereby constitutes one of the most important agents for checking the spread of inflammatory affections Intestinal adhesions often given rise to no symptoms but sometimes they determine attacks of colic and of irregular peristalsis and occasionally an adhesion to the abdominal wall e.g. one springing from the stomach causes a constant localized pain which justifies exploration

4 **Tuberculous Peritonitis**—This disease is almost limited to young people and is usually secondary to some other focus of tuberculosis e.g. in the intestine mesenteric glands Fallopian tube testis etc It is sometimes limited in its development to a portion of the peritoneal cavity especially when originating from the pelvis or vermiform appendix but is more frequently diffuse

Several different types occur which may be associated with or follow one another (1) In the *ascitic* variety the peritoneum becomes thick and hyperæmic and is studded over with tubercles some of them small grey and translucent others larger and undergoing caseation The effusion is generally abundant and consists of straw coloured or opalescent serum perhaps blood stained in the more active cases Flakes of fibrin may be found covering the membrane here and there but there is no extensive matting of the intestines Occasionally the effusion becomes *encysted* giving rise to localized fluid swellings shut in between the coils of intestine (2) In the *fibrous* variety the intestines are matted together by extensive adhesions and between them foci of tubercle are found The mesentery may become infiltrated and shrink fixing the intestines back *en bloc* to the posterior abdominal wall The omentum is often invaded and contracts upwards to form a sausage-like tumour lying transversely above the umbilicus There is but little effusion and that is usually encapsuled It is obvious that such a condition is very likely to lead to obstructive phenomena due to kinking of the intestine (3) The *suppurative* variety is characterized by the presence of tuberculous foci of some size between the coils of intestine caseation and suppuration follow and the abscesses are likely either to open into the intestine possibly into two coils causing thereby a fistulous communication (*fistula bimucosa*) or perhaps to travel

limited lesion of the abdominal contents which is of such a nature as to permit of the general peritoneal cavity being shut off by adhesions the process being thereby localized. It is frequently followed by suppuration the abscess being thus intraperitoneal, although not involving the general peritoneal cavity. The abscesses arising in connection with appendicitis or pelvic peritonitis are not uncommonly of this nature. They may burst through the barrier of adhesions and thus light up a diffuse inflammation of the peritoneal sac, or they may burrow to the surface and point externally, or open into one of the hollow viscera.

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More frequently it is the consequence of some localized injury or inflammation. In the former plastic lymph is deposited over any breach of continuity of the serous membrane, and to this the omentum or intestine becomes adherent, the under surface of a laparotomy wound is not unfrequently affected in this way. Localized areas of inflammation are similarly liable to originate adhesions, which are thus found in connection with gastric ulcers, an inflamed vermiform appendix, enlarged mesenteric glands, or a pyosalpinx. Under favourable circumstances many such adhesions are absorbed in the early stages but if they persist, they are modified by the intestinal movements and are likely to become lengthened and rounded, thus originating the bands and cord like structures so often the causes of acute obstruction. The omentum is frequently involved in this process and thereby constitutes one of the most important agents for checking the spread of inflammatory affections. Intestinal adhesions often give rise to no symptoms, but sometimes they determine attacks of colic and of irregular peristalsis, and occasionally an adhesion to the abdominal wall, *e.g.* one springing from the stomach, causes a constant localized pain which justifies exploration.

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to the surface and open externally and then most frequently at the umbilicus possibly giving rise to a faecal fistula

In each of these varieties acute manifestations may develop at any time as a result of infection from the bowel with the *B. coli* and then the symptoms of acute diffuse peritonitis may supervene

The Symptoms are extremely variable and the early stages of the disease are sometimes not easy to recognize

A few cases have an *acute* onset with abdominal pain and distension and continued pyrexia of a mild type The abdominal wall however is rigid and there is well marked tenderness free fluid is present and though vomiting and constipation exist they are not marked features The patient does not look so ill as the local symptoms would suggest but naturally goes downhill and wastes quickly A careful examination of the pelvic viscera should always be made in girls and young women as this condition is not an uncommon complication of genital tuberculosis

In the more *chronic* forms the earliest symptoms are weakness with some slight abdominal discomfort and not uncommonly diarrhoea alternating perhaps with constipation The temperature becomes of a hectic type and periods of improvement may alternate with attacks of increasing pain and weakness On the whole the patient gradually gets worse his wasted frame comparing markedly with the protuberant and enlarged belly The phenomena discoverable on abdominal palpation vary considerably with the conditions present within

Treatment in the early stages and especially in the acute variety is often successfully undertaken by the physician Hygienic measures of the sanatorium type are adopted the patient living in the fresh air and of course being always in the recumbent position Plenty of good digestible food is given as also cod liver oil and perhaps intestinal antiseptics such as salol creasote etc The external application to the abdomen of iodine either as a paint or an ointment is much commended by some physicians whilst Scott's dressing is relied on by others

Should the condition undergo no improvement it may be justifiable to operate especially when chronic septic accumulation is present All that is needed is to remove the fluid by tapping or laparotomy in the latter case irrigation is not required and the wound should be closed completely in nearly 50 per cent of such cases a cure may be anticipated In the acute form operation is undesirable and but little good results moreover tuberculous infection of the wound often follows the escape of the highly infective fluid from the peritoneal cavity and healing may be thereby delayed Where diffuse or localized suppuration is present adhesions which can be reached may be gently broken down and exit given to the pus but no prolonged search after suppurating foci should be made or the intestine may be torn The results of treatment in this variety are not nearly as satisfactory as in the former

Pneumococcal Peritonitis may arise as a primary manifestation or may be secondary to lesions such as pneumonia empyema or throat and ear trouble caused by pneumococci The primary variety is usually though not entirely seen in young girls of between four and fourteen years

of age, and the infection usually spreads from the vagina by way of the genital passages, it is more common amongst children who are not kept clean and is more often seen in the summer months when the children are more likely to sit about in but little underclothing. In many cases virulent pneumococci are to be isolated from the vaginal secretion of these children. The outbreak is sometimes preceded by slight diarrhoea but the onset is usually sudden and definite in the shape of abdominal pain. This is accompanied by shock, fever, and toxic manifestations often taking the form of drowsiness and confusion, or sometimes of delirium, vomiting is present, and the pulse rapid. The most characteristic feature is that abdominal rigidity is generally slight. After a few days during which the temperature remains steadily high there is a considerable effusion of pus into the peritoneal cavity, accompanied by intermittent abdominal pain, whilst the swelling increases, but the abdomen is still on the soft tumid side. Leucocytosis now becomes more marked. In the third stage the effusion is likely to localize itself to some part of the abdomen—either as a subdiaphragmatic abscess, or one rising up in a dome-like fashion from the pelvis, even encroaching gradually upon the whole cavity, typical dulness may be noted, and the patient wastes rapidly. The abscess sometimes evacuates itself either into one of the viscera or externally, e.g. through the umbilicus and a spontaneous cure may follow. In the more acute cases the course is very similar to the diffuse pyococcal type described above. prostration is generally rapid, and death early, the chief distinguishing features are the presence of looseness of the bowels or even of diarrhoea in some cases, a high leucocyte count, and a less rigid abdomen. The pus is usually like that in a pneumococcal empyema, being greenish yellow in colour and with a faintly sweet smell containing an abundance of false membrane. *Treatment* in the early stages is expectant, consisting in rest in the Fowler position, the administration of opium, and ice to the abdomen. Anti-pneumococcal serum should be used, and whole blood transfusion may be helpful. Most surgeons consider that early operative treatment is of little avail, but when the pus is localizing itself it should always be evacuated and drainage established.

Gonorrhœal Peritonitis almost always occurs in women as a direct extension of a gonococcal inflammation upwards from the uterus, being preceded or accompanied by the phenomena of salpingitis or ovaritis, it has, however, been known to develop in men. There is usually a definite history of gonorrhœa with a more or less abundant discharge, but the attack generally follows a menstrual period or the manipulation of the tubes and ovaries. The onset is sudden and acute the patient complaining of severe pelvic pain, which is accompanied by vomiting, abdominal distension, and fever. A swelling may be felt above the brim of the pelvis. Under suitable treatment the trouble often abates rapidly, and the patient recovers, but adhesions are likely to be left, determining sterility, or the tubes may remain full of pus (pyosalpinx). In other cases exudation is abundant, though there is a tendency to limitation of the trouble, and the prognosis is generally favourable. *Treatment* consists in absolute rest, fomentations to the

abdomen hot vaginal douches and suitable limitation of diet. If rapid improvement does not follow a median laparotomy should be undertaken in order to let out the pus and permit of suitable drainage. The tubes and ovaries should always be explored in such cases and may perhaps need to be removed.

Subphrenic Abscess is the term applied to a suppurating focus which is in more or less intimate relation with the under surface of the diaphragm. Two main varieties are described: the intraperitoneal which is much the more common and the retro- or extra peritoneal. The former are not unfrequently *subhepatic* as well as *subphrenic*.

The causes are very diverse and the manifestations vary somewhat with the causative lesion. (1) The *stomach* is the most frequent source of the trouble the infection being due to the extension of a chronic ulcer. If the *anterior wall* is involved the pus will be limited by the lesser omentum and stomach behind by the diaphragm and left lobe of the liver above by the falciform ligament on the right and by adhesions between the stomach or omentum and anterior abdominal wall below (Fig 698). This type of abscess usually points to the left of the ensiform cartilage. Should the ulcer be situated on the anterior wall near to the fundus the abscess may get into close relationship with the spleen and point beneath the left costal margin. When the abscess arises in relation with the *posterior wall* the lesser sac of the peritoneum may be filled with pus which is prevented from escaping from the foramen of Winslow by adhesions whilst the stomach itself is pushed forwards and the pus travels up and presents above it to the left of the middle line (Fig 699). More often the lesser sac has been previously obliterated and the abscess develops in the retroperitoneal tissues. (2) Ulcer of the *duodenum* may give rise to very similar conditions. If the ulcer is in the first or second part an intraperitoneal abscess is likely to form bounded by the liver colon omentum and anterior abdominal wall occasionally the pus also tracks up behind the liver. When retroperitoneal suppuration occurs in connection with the duodenum the pus travels up between the liver and diaphragm or downwards towards the loin. (3) The *appendix vermiformis* is also a cause of subphrenic abscess the pus burrowing behind the peritoneum or finding its way along the inner or outer walls of the ascending colon.

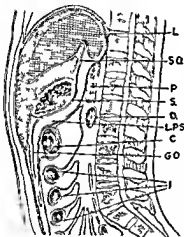


FIG 698. DIAGRAM OF SUBPHRENIC AND SUBHEPATIC ABSCESS DUE TO EXTENSION FROM AN ULCER OF THE ANTERIOR WALL OF THE STOMACH.

S Stomach C colon I small intestine L liver GO great omentum SO small omentum LPS lesser peritoneal sac P pancreas D duodenum.

(4) It may be caused by extension of suppuration from the liver, colon, intestine, or from retroperitoneal structures, such as the kidney, ribs or vertebrae. According to Fenwick, however, 80 per cent of all cases of subphrenic abscess are due to ulceration of the stomach or duodenum.

The abscess may contain pus alone, or, in addition, gas, which is derived either from a direct communication with the bowel, or from the activity of the *B coli*. The presence of the abscess often leads to an upward displacement of the diaphragm, and to a secondary infection of the pleura, either by lymphatic absorption and extension, or by an actual solution of continuity, thereby determining a basal empyema.

The Symptoms vary considerably. They may be preceded by those referable to the causative lesion, or their onset may be sudden.

Ordinary febrile phenomena, and perhaps one or more rigors, may occur, whilst the patient complains of pain in the upper part of the abdomen, together with vomiting and constipation. The pain is often increased on respiratory movements, and may extend upwards to the shoulder. On palpation, the abdominal muscles on one or other side are held rigidly contracted, but possibly a swelling, either dull or tympanic according to its contents, may be noted, and there may be some bulging of the intercostal spaces. On the right side the diaphragm may be pushed up and the liver downwards, and if the abscess contains gas, an area of tympanic resonance may be noted between the dullness of the liver and the resonance of the lung. On the left side the heart may be pushed upwards together with the diaphragm and the absence of lateral displacement of the heart is an important diagnostic feature from a pure empyema or pneumothorax. Radiography will generally demonstrate upward displacement and immobility of the affected half of the diaphragm. A blood count shows a well marked leucocytosis.

The Treatment consists in opening and draining the abscess wherever it is most accessible. In many cases this can be effected through the anterior abdominal wall along the lower margin of the ribs, but even then a counter opening may be needed. When the abscess does not project anteriorly, the best situation for an opening is through the pleural cavity, as for some abscesses of the liver. The incision lies behind the mid axillary line, a portion of the eighth or ninth rib being excised.

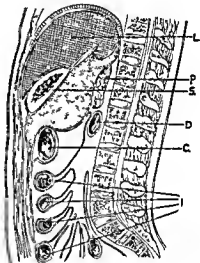


FIG. 699.—DIAGRAM OF SUBPHRENIC ABSCESS IN THE LESSER SAC OF THE PERITONEUM, DUE TO TENSION FROM AN ULCER OF THE POSTERIOR WALL OF THE STOMACH.

S, Stomach, C, colon, I, small intestine, L, liver, P, pancreas, D, duodenum.

If as often happens there is also an empyema this is drained and then an additional opening can be made through the diaphragm if one does not already exist. If however the pleural cavity is not affected the serous membrane covering the upper surface of the diaphragm must be stitched to the parietal pleura before the diaphragm is incised.

Ascites—By this term is meant an accumulation of fluid and that usually of a serous type within the peritoneal cavity. It results chiefly from cirrhosis of the liver, chronic Bright's disease and various cardiac affections but is also a consequence of any obstructive pressure on the portal vein as by malignant glands in the portal fissure secondary to carcinoma of the stomach or of the intestine or by fibrous adhesions the consequence of duodenal ulceration or stones in the gall bladder. Fluid also collects in the abdomen as the result of diffuse malignant deposits scattered over the peritoneum or from the presence of mildly irritative foci such as hydatid cysts etc. *Chylous ascites* is a condition in which the fluid is milky from an admixture of chyle and usually results from rupture of the receptaculum chyli in consequence of the pressure on the thoracic duct of malignant glands secondary to cancer of the stomach. *Encysted ascites* results from the distension of a portion of the cavity which has been shut off by adhesions.

The signs of ascites are easy of recognition. The abdomen is distended like a barrel but with bulging flanks. Dulness is present in the loins when the patient is recumbent and extends forwards to about the same level all round the only resonant area being about the umbilicus this is due to the floating forward of the intestines. On rolling the patient over to one side the dull and resonant areas shift the part that is highest becoming resonant. This sign is occasionally absent if the mesentery is short or if the intestines are tied down posteriorly. On flicking the abdomen a well marked thrill is usually transmitted from one side to the other. Necessarily the fluid also finds its way into any diverticula of the peritoneum such as an unclosed funicular process or a hernial sac. The diagnosis of ascites is not difficult but the recognition of its cause may not be easy until the fluid has been removed so that the abdominal viscera become palpable. Light may also be thrown on an obscure case by a cytological examination of the fluid in malignant disease cancer cells and blood may often be found.

Treatment necessarily varies with the cause of the accumulation. Should it persist and the patient's breathing be hampered by the abdominal distension removal by *paracentesis* is essential. The usual plan is to seat the patient on a chair and to encircle the abdomen with a flannel binder the ends of which are split to within 6 inches of the middle line. The unsplit portion is placed over the abdominal wall in front and the divided portions cross behind and are held by assistants so as to maintain continuous pressure. The bladder is emptied and then the abdomen is percussed and a spot of absolute dullness selected here a small incision is made after purification of the skin and a suitable trocar and cannula inserted. The median line below the umbilicus is the place usually chosen for the puncture but there is no objection to inserting the trocar through the flanks. If it is desirable to withdraw the fluid more slowly so as to prevent the shock often

experienced from its rapid removal, two or three small sized trocars and cannulæ may be inserted

In cases due to hepatic cirrhosis, **Epiploexy** (the Talma-Morison operation) may possibly be of some use. The object is to relieve the obstruction to the portal system by opening up fresh communications between it and the systemic veins. The method consists in fixing the great omentum to the abdominal wall and determining the formation of adhesions. necessarily the peritoneum has to be drained and kept dry during this procedure, and the question arises as to whether this drainage is not the cause of the improvement. The mortality is not inconsiderable especially when the liver is small. the best results have been gained with hypertrophic cirrhosis

Affections of the Great Omentum.

The omentum is of great surgical importance in the abdomen, in that it covers in and protects the viscera and by its mobility is able to apply itself to many a weak spot where perforation or infection might occur, and thereby guard the patient from serious inflammatory mischief. The result of this process is, however, the formation of adhesions which by the irritation of constant movement may stretch and become rounded and cord like and various forms of intestinal obstruction (by strangulation, kinking, etc.) may result therefrom. The value of this protective power of the omentum is recognized by surgeons in the employment of *omental grafts* to add security to a line of junction in the intestinal wall with which they are not quite satisfied. The best method to adopt is to detach the graft entirely from its former connections, wrap it round the gut and stitch it in place.

The omentum may be torn and holes may be formed in it as a result of injury. The immediate symptoms are pain, shock and the phenomena of intraperitoneal hæmorrhage, but it is likely that other injuries co exist. At a later date the hole might be the site of internal strangulation.

Acute Inflammation (epiploitis) has been lighted up as a result of the application of a septic ligature to the omentum in a hernia operation. The phenomena vary with the virulence of the organisms, an acute diffuse peritonitis perhaps resulting. In the milder forms a localized inflammatory disturbance follows, with all the phenomena of a limited peritonitis, suppuration may ensue and a large intra-peritoneal collection of pus may develop.

Torsion of the omentum is an occasional complication of an irreducible hernia, and that usually on the right side. The lesion generally follows some heavy strain, and results in venous stasis, effusion of a blood stained fluid, the formation of extensive adhesions and possibly gangrene and general peritonitis if left long enough. The symptoms often start abruptly with colicky pain in the right iliac fossa and scrotum enlarged, and extending upwards from the iliac region a sensitive mass may be detected on palpation, which is dull on percussion, and sometimes reaches to the epigastrium. The temperature is normal, though

the pulse-rate is accelerated. Treatment is obviously operative and consists in removal of the omentum.

Chronic peritonitis whether simple or tuberculous may cause the omentum to be rolled up into a more or less solid mass which lies transversely across the abdomen a little above the umbilicus. There is usually a band of clear resonance between it and the hepatic dulness which is of great diagnostic importance.

The omentum also becomes infiltrated with secondary cancerous nodules which can sometimes be palpated and their presence is always an important indication as to the undesirability of operative treatment. Colloid degeneration is not uncommon in omental cancers and huge masses of this growth have been sometimes discovered in the dead house. Omental carcinoma usually leads to a considerable effusion of fluid into the peritoneal sac.

Affections of the Mesentery

Wounds may be caused by penetrating or non penetrating injuries. They are usually associated with laceration of the intestine and the resulting phenomena will be those of hæmorrhage followed by general peritonitis from the intestinal lesion. Simple mesenteric wounds not involving the bowel are generally due to penetrating or gunshot injuries. Hæmorrhage to a varying degree may follow and if the patient lives the nutrition of the intestine may be seriously endangered. If such a lesion is found on exploration bleeding points must be secured and the opening in the mesentery closed but before this is undertaken careful consideration must be given to the vascular supply of the intestine as the ligation of a main branch of a mesenteric artery may determine gangrene and necessitate resection of a portion of the bowel.

Thrombosis of the Mesenteric Vessels, apart from strangulation or volvulus is usually the result of embolic obstruction of the artery but may sometimes commence in the veins spreading down from the liver or originating in some intestinal ulcer. The process is associated with acute pain and is followed by the symptoms of acute obstruction. The bowel becomes engorged with venous blood and dies its lumen is often occupied by a blood stained effusion and the passage of dark tarry stools may be noted. The peritoneal cavity contains a quantity of blood stained serum which after a time becomes offensive. A diagnosis is rarely reached apart from operation for the obstructive phenomena and the only hope for the patient is removal of the gangrenous bowel (if that be possible) and a temporary enterostomy. Should the patient live (a very doubtful contingency) the continuity of the gut may be subsequently restored.

The **Mesenteric Glands** are frequently inflamed in consequence of intestinal lesions *e.g.* typhoid ulceration or chronic appendicitis. No special notice is taken of this occurrence unless suppuration ensues, when the abscess must be opened. In less severe cases however it is often associated with a patch of localized peritonitis resulting in the deposit of plastic lymph to this some other viscus *e.g.* the free end of the omentum the imbricated extremity of the Fallopian tube the

verruiform appendix, one of the appendices epiploicæ, etc., may become adherent and an adhesion may develop which subsequently leads to intestinal obstruction. As a matter of fact, the great majority of intra abdominal bands are connected at one end with the mesentery.

Tuberculous Disease of the mesenteric glands is a common affection in children, constituting a condition known as *tabes mesenterica*. It is probably secondary to intestinal lesions and when widely diffused through the mesentery is, of course, to be dealt with only by hygienic and medical measures. The results of such treatment are frequently very satisfactory, but tuberculous peritonitis may follow. Sometimes the glands undergo calcification, and these may lead to a mistaken diagnosis if a patient is examined radiographically for supposed ureteral calculus. At other times the caseated glands may liquefy and give rise to an inflammatory attack that may be mistaken for appendicitis if the mesentery of the lower end of the ileum is involved. Limited masses in the iliac fossa may sometimes be amenable to surgical measures, and are removed, and occasionally the surgeon has to deal with a gland which has suppurated and requires to be opened. Adhesions also form between the glands and surrounding parts, and intestinal obstruction may result.

Cysts of the mesentery are not common and are usually of lymphatic origin, they may be single, containing either lymph or chyle, or multiple, then constituting a cavernous lymphangioma. Blood cysts have been known, and also dermoids, which are usually located in the mesentery of the ileum. A rounded tense intra abdominal swelling gradually develops behind or below the umbilicus, it is freely movable from side to side, and is usually accompanied by some derangement of intestinal function. When of large size, the swelling is dull, but is often crossed by the affected loop of bowel, it may possibly be mistaken either for an ovarian or a pancreatic cyst. The diagnosis is usually made on the operating table, and the treatment consists in enucleation or drainage, with or without removal of the affected coil of intestine.

Tumours form occasionally in the root of the mesentery and behind it, constituting the retroperitoneal lipoma or sarcoma. The former may grow to a large size, and destroy life by its pressure phenomena, the latter, though sometimes resembling the former in structure, invades surrounding tissues earlier. The diagnosis is uncertain until the abdomen is opened, and the question of removal is dependent on the relation of the growth to the mesenteric vessels, which must not be injured. It is seldom that a retroperitoneal sarcoma can be enucleated, and treatment by irradiation must be employed.

Affections of the Stomach.

The cardiac orifice lies about 4 inches behind the junction of the seventh costal cartilage with the sternum, the highest part of the fundus reaches the fifth left rib in the mammary line, the pylorus when the stomach is empty is in the middle line midway between the supra-sternal notch and the symphysis pubis (Addison's transpyloric plane). When the stomach is full, the pylorus passes more or less to the right

of the middle line and descends slightly. The lower border can usually be defined with tolerable accuracy by auscultatory percussion; this is performed by applying a stethoscope over the centre of the stomach area and percussing outwards over the margin. A change in note is readily recognized on reaching the border of the stomach.

When the stomach is pathologically dilated the pylorus and lesser curvature are retained more or less in position by the gastro-hepatic omentum, so that the organ pouches down towards the pelvis and becomes an elongated sac in which fluids accumulate and decompose and gas collects. Peristaltic waves can often be seen crossing the viscus and on succussion or tapping the organ with the finger tips gurgling and splashing sounds are heard.

Radiography has also proved of service in demonstrating the activity and shape of the stomach after the administration of a barium meal which consists of a mixture of 2 or 3 ounces of barium sulphate in gruel or bread and milk. X-ray photographs or screen examinations are then made at intervals so that the changes in shape of the stomach as indicated by the shadow cast by the barium can be ascertained.

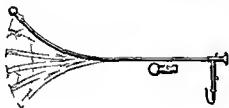


FIG. 100.—GASTROSCOPE.

The greater curvature of the stomach should reach to a little below the level of the umbilicus (this owing to the weight of the barium meal) and the viscus should empty itself in about four hours. The shape of the pyloric end is also a matter of great significance. Considerable variations in the results however occur according to the position of

the patient during the examination, e.g. whether erect or recumbent; the latter possibly gives more accurate information.

Gastroscopy has of late become a useful adjunct to the surgeon since the introduction of the flexible gastroscope. The contra-indications are the same as for the introduction of any tube into the stomach, namely aneurysm, carcinoma of the cardia and œsophageal varices. The modern flexible gastroscope (Fig. 100) has three main advantages: (1) safety, (2) visualization of the greater part of the stomach, (3) minimum of discomfort.

The movements of the stomach can also be observed. Ulcers on the lesser curvature and early carcinomas can now be definitely diagnosed with this instrument. Duodenal ulcer and the juxta pyloric ulcer however remain invisible and must be diagnosed by means of radiography.

Much may be learnt of the functions of the stomach by a careful examination of its contents and secretions. It is a simple and often very valuable procedure to remove the gastric residuum by means of a Reyfuss tube and a 20 c.c. syringe. The patient is allowed no food or drink overnight, i.e. for twelve hours or more, and the

contents of the fasting stomach are then withdrawn and examined as follows

(a) *Chemically*—The normal volume of the gastric residuum varies from 20 to 50 c c a quantity greatly in excess of this suggests dilatation of the stomach. The average normal total acidity is about 0.11 gm per cent calculated as hydrochloric acid the average normal content of free hydrochloric acid is about 0.07 gm per cent. About 10 per cent of healthy individuals, however, exhibit hyperchlorhydria, and about 4 per cent achlorhydria. The presence of organic acids *e.g.* lactic acid is pathological indicating the existence of fermentation which can only occur in the more or less complete absence of free HCl because the organisms responsible for this change cannot thrive in an acid medium. The finding of blood may be significant, if one can exclude its origin from the gums or mouth, or from injury by the tube. The presence of bile denotes regurgitation from the duodenum but this is really of little significance, as it has been demonstrated in a certain proportion of healthy individuals. There should not be more than a trace of mucus and no starch should be present.

(b) *Microscopically*—There should not be any cells food residue, or organisms other than those derived from the mouth by swallowing the saliva. In pathological conditions pus cells may be found, as also red blood corpuscles, endothelial (wandering) cells with phagocytosed blood pigment or rarely tumour cells. Squamous epithelial cells are of no significance, being frequently detached from the mouth pharynx, or œsophagus. Starch granules, cellulose remains, or undigested muscle fibres indicate great delay in digestion.

(c) *Bacteriological* examination is generally regarded as of little value. Boas Oppler bacilli are fairly common whenever lactic acid fermentation occurs, and are accordingly not unusual in gastric carcinoma.

The chief value of examining the gastric residuum is that the microscopical picture is not lost in a host of starch granules and yeast cells as in the Ewald test meal. The disadvantage is that it is not an investigation of the response to a stimulus.

In the original Ewald test meal toast without butter and tea without milk were administered on a fasting stomach. At the end of one hour the gastric contents were withdrawn and examined as outlined above. Under these conditions the average normal total acidity is 0.15 to 0.26 gm per cent, estimated as HCl, and the free HCl 0.07 to 0.15 gm per cent. This test is improved by a preliminary withdrawal of the gastric residuum, which in particular cases may amount to several hundred c c of fluid, and so materially affect the results.

The Ewald test meal has been largely replaced by fractional methods of gastric analysis, because it has been shown that the acidity values vary considerably at different intervals after the meal. In the fractional test meal a Rejzuss or other tube is passed after a night's fast, and the gastric residuum removed and examined. With the tube *in situ* a meal of oatmeal gruel previously strained through muslin is given, and at intervals of fifteen or twenty minutes a small sample (5 to 10 c c) of the gastric contents is removed until the stomach is empty. The acidity results are plotted and the form of the curve

The diagnosis and treatment rest rather with the physician than with the surgeon, but his assistance is always required in cases of perforation and sometimes he is consulted concerning hemorrhage. The symptoms and treatment of *Perforation* are very similar to those for the chronic variety, and need not be discussed separately. As regards the treatment of *Hæmorrhage*, the surgeon must never be tempted lightly to undertake operative measures in the hope of finding and dealing with the bleeding point. The condition is rarely fatal, and reliance must be placed on the usual medical measures: i.e. complete rest to the organ both physical and physiological, the administration of morphia, possibly the application of an ice compress to the abdomen, the hypodermic injection of blood-serum, as a hæmostatic or a whole-blood transfusion, and the rectal infusion of an abundance of salt and



FIG. 61 — ACUTE ULCERS OF STOMACH (KING'S COLLEGE HOSPITAL MUSEUM)



FIG. 60 — CHRONIC ULCER OF STOMACH (KING'S COLLEGE HOSPITAL MUSEUM)

water with glucose. All sources of infection in the mouth, nose or pharynx should be dealt with and if the bleeding recurs seriously, it may be desirable to explore the abdomen for other sources of trouble, e.g. the appendix or biliary tracts but not until the bleeding has ceased and the patient's condition justifies it. Of course, other causes of gastric hæmorrhage connected with the liver, spleen or heart must be remembered and taken into consideration.

(b) The Chronic Ulcer of the Stomach (Fig. 702) is a much more serious condition and has a definite mortality. It occurs in men twice as often as in women and usually appears between the ages of thirty and fifty years. The origin of this condition is not very clear, but it is supposed with no great evidence, to supervene on the acute ulcer. It may attain considerable dimensions, perhaps many

square inches of surface being involved. It is usually single, and situated near the pyloric end or on the lesser curvature. Its shape is very variable though in the early stages it is rounded, one important type is the horseshoe ulcer, which spreads down, along both surfaces from the lesser curvature, and may subsequently cause an hour glass contraction of the organ. The edges are often raised hard, and infiltrated whilst the gastric wall is generally thick and sclerosed. In old standing cases there may be considerable destruction of tissue surrounding viscera, such as the pancreas being sometimes exposed thereby. Various complications will be alluded to later, viz hæmorrhage perforation, perigastric inflammation, and stenosis.

It is impossible to discuss the *Symptoms in extenso*, medical works must be consulted for a full consideration of that subject. It must suffice here to indicate the more important points. The patient is generally brought under observation for *Pain*, which has probably already lasted for some time, it is referred to the epigastric region and to the back, and is accompanied by a tender spot a little below the ensiform cartilage (Fig 703), and by muscular rigidity of the upper part of the abdominal wall. It develops frequently at night, and may be sufficiently severe to waken the patient. Its relation to the ingestion of food is interesting, in that there is usually an interval of freedom after meals, lasting from a quarter of an hour up to perhaps two hours, increasing with the nearness of the ulcer to the pylorus, rest and careful dieting relieve this symptom, as also the vomiting, which is of pretty constant occurrence in this condition. *Hæmorrhage* is very liable to take place, if in small quantities, it may be occult, and must be looked for in the feces microscopically or chemically, but if abundant, it becomes obvious either as hæmatemesis or melæna, and may prove fatal before help can be given. The quantitative and qualitative examination of the gastric contents may throw some light on the case, but the results, though interesting are not as a rule absolute. *Radiography*, on the other hand, is really helpful, but requires expert assistance. It is possible for some of the barium of a test meal to remain in the hollow of the ulcer, and it can sometimes be seen, especially in profile, as an abiding dark patch. Irregularity in filling of the organ and abnormalities of the duodenal cap also occur, whilst contraction of the

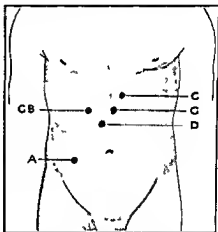


FIG 703 —TENDER SPOTS IN ABDOMINAL LESIONS

- C In ulcer of stomach near the cardiac orifice G in the ordinary type of gastric ulcer, D, in duodenal ulcer GB in affections of the gall bladder A, in appendicitis

stomach may lead to a constriction deformity easily recognizable

The course of such a case of chronic ulcer is often prolonged. Periods of improvement as a result of rest and careful dieting alternate with attacks of pain and vomiting and at any time the complications noted below may supervene. Finally it is possible that carcinoma may develop on the site of a chronic ulcer.

Treatment in the earlier stages consists of rest and diet with careful attention to local foci of infection or other general affections and will therefore be of a medical character in the first place. Only when such measures fail and the patient is the subject of repeated relapses interfering seriously perhaps with his health and prospects or when grave complications occur threatening life itself is surgical assistance required. The object to be attained is not merely to give a measure of relief possibly a little longer than that secured by medical means but also if possible to put the patient beyond the chances of relapse the dangers of complications or the risks of a carcinomatous development. At the same time the operative measures must not be associated with undue mortality or with post operative discomforts or disabilities that are nearly as bad as the condition for which they were undertaken.

Many different procedures have been tested and their value by now has been fairly well estimated. *Simple excision* of the ulcer is satisfactory if the lesion is so situated and of such a size and shape as leaves the stomach subsequently without gross deformity. Too often excision interferes seriously with the shape of the organ and thereby with its satisfactory function and therefore this procedure is often impracticable. Sometimes too the stomach is so fixed especially posteriorly as to render excision so risky as to be undesirable. *Gastro enterostomy* has been very largely employed for this condition and in suitable cases the results have been good. There has been much discussion as to the reason for this improvement and two distinct grounds have been alleged: (1) That it is merely due to the *mechanical* effect of permitting the viscus to empty itself more quickly thereby preventing the acid chyme from passing over and irritating the raw surface of the ulcer. There is no question that where stenosis occurs at or near the pylorus this suggestion is true. It emphasizes the importance of always making the anastomosis on the proximal side of the lesion. It does not explain however the improvement in all cases. (2) A *chemical* element is probably present and also enters into the problem. A gastric ulcer is usually associated with hyperacidity and unless this is corrected by the operation symptoms persist and even gastro-jejunal ulcers develop. It is likely that the reduction of acidity is due to the entry of biliary and pancreatic secretions both through the artificial stoma and through the pylorus. This suggestion has to be confirmed by further observations but already there are surgeons who are attempting to cure these cases by merely making a communication between the gall bladder and the stomach (*cholecysto-gastrostomy*) whether or not such treatment will be justified by results remains to be proved. In a certain number of cases the operation of choice is

undoubtedly *partial gastrectomy*, removing the pyloric half of the stomach, and connecting the proximal end of the jejunum to the cardiac section that is left (Figs 710 and 711). As at present undertaken (*vide infra*), the mortality rate of this proceeding is comparatively small, and it has the advantage that, should carcinomatous transformation of the ulcer have already commenced, no secondary operation is required.

The Complications of ulcers of the stomach which call for surgical assistance are alike for the acute and chronic varieties, and may be considered together.

1 **Excessive and Persistent Hæmorrhage** is responsible for a considerable proportion of the deaths from gastric ulcer. In the *acute* superficial form that occurs in young women, it is usually derived from some small arteriole, but, as suggested above, does not require operative treatment. Rightly handled, it is not a fatal condition. In the more *chronic* ulcers serious hæmorrhage may be derived from vessels of greater size, and then may even prove fatal before help can be given. Thus one of the larger branches of the coronary artery may be involved or one of the enlarged varicose veins which are often found in the neighbourhood of an old ulcer, where there has been much destruction of the posterior wall, the base may be formed by the structures lying behind the lesser peritoneal sac, *eg* the pancreas, and the splenic artery is then sometimes opened, and an immediate fatality results. The treatment of this condition is still open to discussion, the majority of surgeons agree that it is usually unwise to operate whilst the bleeding persists, and that subsequent operations should be directed to the ulcer rather than merely to the hæmorrhage.

2 **Perforation** is by no means an uncommon occurrence, and unless recognized and treated early is fraught with the greatest danger. The anterior wall is more frequently involved than the posterior (7 to 1), owing to its greater mobility, which prevents the formation of protective adhesions. The cardiac end is more often affected in young people, but in middle-aged people with chronic ulcers the majority of perforations are to be found near the pylorus and towards the lesser curvature. The character of the perforation varies considerably, it may be as small as a pin prick or as large as a threepenny-piece. The margins may be œdematous and inflamed or in cases associated with chronic ulcers may be thick and cicatricial in character, with no tendency to close spontaneously.

The **Symptoms** necessarily vary with the size of the perforation, and with the distension or not of the viscus. If a large opening is produced in the anterior wall, so that the gastric contents are allowed a free entrance into the peritoneal cavity, the patient is seized with severe epigastric pain and profound shock, and this is quickly followed by acute diffuse peritonitis, which soon proves fatal if surgical assistance is not at hand. When the perforation is small and the stomach empty, the initial symptoms of pain and shock may quiet down in twenty-four hours and the patient recover spontaneously, the opening is then closed by lymph or the omentum. More frequently, however, a moderate degree of leakage occurs, the onset is characterized by acute pain, possibly during or just after a meal, and central in position, there

is a certain degree of shock, but it passes off in an hour or two if the patient is kept quietly recumbent, the pain persists, the upper part of the abdomen becomes rigid and intensely tender, and gradually the phenomena of acute diffuse peritonitis supervene.

The **Prognosis** of gastric perforation is exceedingly grave, since, unless active surgical treatment is obtainable within a comparatively short time, hopeless peritonitis ensues. Statistics indicate that 95 per cent. of untreated patients die, and that the later the operation, the worse the results. If operation is undertaken within six hours, recovery is usual, if within twelve hours, it is not unusual, but later than that it is very uncertain.

Treatment—Should it be decided for any particular reason not to operate in a given case the horizontal position, rectal feeding, and the use of morphia to check peristalsis are the only means which hold out any prospect of benefit. Operation, as already indicated, must be undertaken at as early a period as possible, although it may be wise to wait for a few hours to allow the patient to recover in measure from the initial shock. A median or paramedian incision is the best to employ, since it is not possible to be certain as to the situation of the lesion. The rules given before as to the treatment of a penetrating injury hold good in connection with this subject, especially as to the use of swabs or suction for the removal of any extravasated gastric contents and as to the value of peritoneal irrigation. There is no need to excise the ulcer when found, all that is required is to close the aperture by means of Lembert's sutures, which infold and bury the perforation, this is sometimes a matter of some difficulty when the margins are thick and sclerosed, an omental graft is valuable in these cases. Occasionally it may seem unwise to attempt closure of the perforation, and in others it may be so situated as to render such closure impossible. A drainage-tube, free from lateral openings, is then introduced into the stomach, and gauze packed around it so as to lessen the risk of intraperitoneal leakage. The patient is fed by the rectum for some time and the fistula usually closes without much difficulty at a subsequent date.

After treatment is as for all cases of diffuse septic peritonitis. The patient is placed as soon as possible in the sitting position. Mouth-feeding is of course forbidden for a day or two and rectal alimentation relied on. Turpentine enemata are employed to relieve distension and empty the bowel.

3 **Perigastric Inflammation** is a common result of ulceration, it may be either adhesive or suppurative in character.

Adhesive Perigastritis is in the first place protective in nature, consisting of a localized thickening of the serous wall. It is more marked in connection with chronic than with acute ulcers. The posterior gastric wall often becomes adherent across the lesser sac of the peritoneum to the serous membrane lying in front of the pancreas, and this fixity may be one of the factors which prevent the ulcer from healing, even as fixation to the periosteum over the tibia delays healing in an ulcer of the leg.

In a few cases adhesions form between the anterior wall of the

PLATE XXI



GASTRIC ULCER CAUSING HOUR GLASS CONTRACTION

Note the barium filled excrescence on the lesser curvature and the deep niche opposite to it along the greater curvature (Confirmed by operation)

stomach and the parietal peritoneum and these may give rise to a localized fixed epigastric pain usually increased considerably by distension of the organ internal strangulation or obstruction may also be thereby determined It can sometimes be treated by division of the adhesion between ligatures

Suppurative Perigastritis may follow a small perforation with limited leakage but is more usually due to a gradual extension of the ulcer and an invasion of the perigastric tissues by organisms which escape from the stomach The result of this is the formation of what has been already described as a subphrenic abscess which may or may not contain gas It may burst anteriorly through the abdominal wall or may perforate the diaphragm giving rise to a basal empyema and this in turn may burst into the lung or through the chest wall so that fistulae may appear in various places through which the contents of the stomach may be discharged

The abscess must be opened and drained in the way already indicated but should a fistula form it is almost hopeless to attempt to deal with it locally and a gastro enterostomy may then be required

4 Stenosis is always liable to follow the cicatrization of ulcers of the stomach In the small acute ulcer the contraction rarely leads to more than a puckering of the organ but in the chronic ulcers of large size the organ may be much altered in shape and definite stenosis may arise If the contraction is in or near the cardiac orifice symptoms akin to oesophageal stenosis may be produced the patient returning his food shortly after swallowing it If the pylorus is affected the stomach is often much dilated and vomiting of a special type ensues (see Simple Stenosis of the Pylorus) It is important to note that muscular spasm due to hyperchlorhydria plays a considerable part in the production of these symptoms in cases of ulcer

The most exaggerated forms of gastric stenosis follow the cicatrization of a horseshoe ulcer and this constitutes the most common cause of an hour-glass stomach, adhesive perigastritis and cancer are also occasional causes The constriction is usually situated about 4 inches from the pylorus and may be so narrow as almost to divide the organ into two halves Generally the great convexity is drawn up towards the lesser and thereby two pouches are formed which sag downwards in them food collects and undergoes decomposition Vomiting more or less of a pyloric type ensues from the distension of the cardiac pouch which is usually much the larger On washing out the organ with a measured quantity of water a smaller quantity often returns some being retained in the lesser sac On palpation this latter may occasion a succussion splash even when the organ is apparently empty On again passing the tube after a short interval offensive fluid may return especially if the pyloric pouch has been palpated Distension of the viscus causes a definite bulging on the left side of the epigastrium in the first place subsequently this may diminish and the pyloric pouch become evident on the right side Sometimes both pouches can be distinctly felt or even seen as well as the sulcus between them Radiography after a barium meal will often demonstrate satisfactorily the existence of this condition (Plate XVI)

The most effective Treatment undoubtedly consists in total excision of the narrowed segment and the subsequent restoration of the stomach to a normal condition. If this for any reason be impossible it may be feasible to excise the distal pouch and perform a gastro-enterostomy between the jejunum and the proximal segment or to connect the two pouches together close to the greater curvature so that the proximal drains into the distal and thereby distension is prevented. Either of these procedures is better than the performance of a double gastro-enterostomy in which each pouch is connected with the jejunum an operation which should not be undertaken if it can be avoided.

Fibromatosis of the Stomach or plastic limitis cirrhosis of the stomach is a very rare disease characterized by a diffuse fibrous thickening of the submucous coat of the stomach (Fig 704). The aetiology of this condition has been much discussed some writers

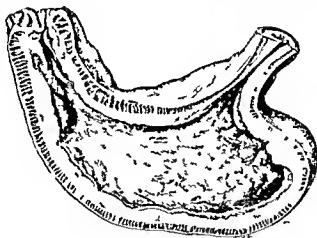


FIG 704 FIBROMATOSIS OF THE STOMACH (MUSEUM OF THE ROYAL COLLEGE OF SURGEONS)

considering that it is secondary to diffuse atrophic carcinoma and others that it is innocent. The condition has no connection whatever with syphilis or tuberculosis.

It is more common in men than in women and may be considered a disease of adult life. The stomach may first be of normal size but later becomes contracted. It has a whitish or pearly white appearance which is characteristic. On section (Fig 704) the wall of the stomach is found to be much thickened the submucous coat being especially affected. The mucous membrane is normal or may at times be ulcerated. The thickening is usually most pronounced in the pyloric region where ulcers are common and the condition is possibly due to infection from this source.

The symptoms produced by fibromatosis are naturally vague and the diagnosis is rarely made except by X ray examination.

With regard to treatment gastrectomy should be performed where possible but it may be difficult on the operating table to differentiate between this condition and cancer.

Cancer of the Stomach—The stomach is more frequently invaded by cancer than any other organ in the body in the male sex whilst in females it comes next to the breast and uterus in order of frequency. Any and every part of the viscus may be affected but in about 60 per cent. of the cases the tumour starts in or near the pylorus. It may be of a spheroidal or columnar celled type but is often sufficiently hard to warrant the use of the term scirrhus. When the cardiac end is attacked the disease may spread from the oesophagus and is a



FIG. 705—CANCER OF PYLORIC END OF STOMACH (KING'S COLLEGE HOSPITAL MUSEUM)

The abrupt limitation of the growth at the commencement of the duodenum is well seen

squamous epithelioma but when the body of the organ is invaded the condition is generally a columnar carcinoma.

Cancer sometimes starts at the site of an old ulcer but often there is no assignable cause for its onset except an indefinite history of injury. It may occur as a nodular outgrowth perhaps covered with papillomatous projections and early undergoing ulceration. If it is of a hard type the ulcerated surface has a characteristic everted margin. Sometimes the whole organ becomes infiltrated by a diffuse carcinomatous growth constituting a firm mass incapable of dilatation or much contraction which has been aptly termed the leather bottle stomach. At the pyloric end (Fig. 705) the tumour is always of a hard nature, and forms an annular constriction through which it may be difficult

to pass even a small catheter it is sharply limited on its duodenal aspect but spreads into the body of the organ and especially towards the lesser curvature following the main line of the lymphatic stream. The lymphatic glands lying along the lesser curvature are involved usually extending as far as the point where the coronary artery reaches the stomach whilst those along the pyloric end of the great curvature are implicated to a less degree (Fig 707). Thence the affection spreads to the liver and to the coeliac glands and may there compress the inferior vena cava and thoracic duct. Adhesions form around the growth but are relatively later in appearance than in a simple ulcer they may fix the tumour to the under-surface of the liver to the head of the pancreas the colon and even when of large size to the anterior abdominal wall. These adhesions often prepare the way for an extension of the disease to the peritoneum over which disseminated nodules of cancer may be scattered giving rise to a considerable effusion of serous fluid. The omentum also becomes infiltrated and colloid degeneration is not unusual in this region the omentum being converted into a solid translucent mass looking sometimes like firm sago pudding.

Speaking generally the malignancy of gastric carcinoma is decidedly less than that of such organs as the breast or uterus in that secondary glandular affections are later in developing and even when the nearest group is involved it may be some time before the affection spreads to distant parts.

Clinical Phenomena.—Gastric cancer begins with certain indefinite symptoms the significance of which is easily overlooked in the early stages so that a thorough and exhaustive examination is not made and the time for radical interference passes without the disease being recognized. Pain is generally the earliest symptom slight at first but gradually increasing and referred to the epigastrium or back. Food may increase or relieve it but as time progresses the pain comes on independently of meals. Acid eructations and a sense of epigastric oppression soon follow and these in time give place to actual attacks of vomiting the ejecta perhaps containing blood but usually not till late in the case and as a rule not in great quantity. Loss of appetite and steady wasting are also marked features in the early stages but the patient usually has a clean tongue. The persistence of such a group of symptoms should always determine a complete investigation of the stomach and its functions. Gastric symptoms occurring for the first time after the age of forty five or fifty presuppose cancer until proved otherwise. (1.) The epigastric region is carefully palpated and the nature and position of any unusual swelling noted. (2.) The composition of the gastric juice is investigated chemically. In cancer the amount of HCl is usually diminished whilst that of lactic acid is increased. This test must be looked on as a valuable but not as a constant indication of the presence of cancer. HCl is generally increased and not diminished if cancer supervenes on a chronic ulcer. Moreover HCl is absent in many gastric lesions other than cancer and hence the results of this investigation must always be considered in conjunction

with the clinical symptoms (iii) The motor power of the viscus is very considerably lessened, so that the passage of its contents into the duodenum is delayed, this is due to a chronic interstitial gastritis (iv) A blood-count in carcinoma usually reveals a well marked secondary anaemia, together with a moderate leucocytosis (v) Microscopic examination of the vomit may also throw light on the case by the discovery of fragments of the growth, and occult blood may be present in the faeces (vi) Radiographic examination after a barium meal may reveal a marked change of shape of the normal shadow or even the actual outline of an excavated ulcer (Fig 706)

To these general signs certain special ones may be added, varying with the location of the growth

1 If the *cardiac end* is involved, a tumour can rarely be detected the stomach being small and contracted, the patient complains chiefly of pain on swallowing, and the vomiting occurs almost immediately after each meal. The symptoms are practically those of oesophageal cancer

2 When the *pylorus* is affected, a tumour can often be felt a little above and to the right of the umbilicus which is at first rounded and nodular, it is movable in the early stages, but later on becomes fixed

by adhesions, it is firm in consistence, and somewhat tender on manipulation and pressure, and may receive pulsation from the underlying aorta. The pylorus almost invariably becomes contracted, and the stomach dilated, and its great curvature displaced downwards, perhaps almost into the pelvis. In this a large accumulation of fluid takes place, which can be heard splashing about when the patient is moved, every day or two he brings up a large quantity of fluid and decomposing food covered with a yeast like scum, and sometimes containing sarcine in abundance. *Hæmatemesis* is not uncommon

3 When the *body of the organ* is involved, a tumour may or may not be felt, according to its situation. In these cases pain and vomit-



FIG 706—SKIAGRAM OF CARCINOMA OF THE STOMACH

Note the 'filling defects' in the pyloric antrum and of the lesser curvature of the pars pylorica

ing are sometimes comparatively slight especially if the exit through the pylorus is not obstructed and thus the tumour may attain considerable proportions before it is discovered. The leather bottle stomach can be sometimes detected as a solid mass emerging from under the left costal margin the organ is not dilated and the vomiting has no special characters but hæmatemesis is usually absent and dyspeptic phenomena are pronounced.

In the later stages of all types pressure phenomena manifest themselves e.g. ascites from compression of the portal vein jaundice from implication of the common bile-duct œdema of the legs and varix of the superficial abdominal veins from pressure upon the inferior vena cava while the peritoneal cavity may be distended with chyle owing to the pressure of lymphatic glands on the receptaculum chyli or thoracic duct. All the e later signs are indications that the time has passed when radical treatment is possible. A similar indication is given by enlargement of glands in the left supraclavicular fossa which results from dissemination of cancer cells up the thoracic duct.

Treatment—When the symptoms of chronic gastritis persist in spite of careful dieting and treatment and the patient is losing flesh one should always look on the case with suspicion. Granted that the examination of the gastric juice reveals the characteristic changes referred to above and still more when a blood-count indicates leucocytosis and a diminishing quantity of hæmoglobin then an exploratory operation is quite justifiable whether a tumour is to be felt or not. On the other hand the mere discovery of a tumour in the epigastrium does not justify an operation. It is quite possible that under such circumstances the disease has spread beyond the reach of surgery and therefore unless there are distinct indications for palliative treatment e.g. the signs of pyloric stenosis the patient is better left alone. Of course in many cases an operation is urged in the almost vain hope of being able to do something but when ascites jaundice or definite evidences of dissemination are present the surgeon should never interfere.

For cancer of the cardiac orifice gastrostomy may possibly be desirable the artificial stoma being placed nearer to the pylorus than usual or jejunostomy may be better.

For cancer of the body of the stomach a partial or total gastrectomy may be feasible in the absence of massive adhesions. If this is impossible and there is evidence of obstruction to the passage of food a gastro-enterostomy is undertaken owing to the usual location of the carcinoma on the posterior wall the surgeon may have to employ the anterior operation. Sometimes the disease is so extensive that even this procedure is impracticable the patient's nutrition is then likely to fail rapidly but life may sometimes be prolonged (if such be desirable) by establishing a jejunal fistula through which he may be fed.

For cancer of the pylorus operation is more frequently possible. If the mass is comparatively movable with but few adhesions removal of the diseased portion together with the lymphatic glands on the

great and lesser curvatures (Fig 707) may be undertaken and even should secondary deposits be present in the liver the patient is probably better off after such a procedure than if left alone. When the growth is firmly adherent gastro enterostomy may be required for obstruction to the passage of food.

Simple Stenosis of the Pylorus results from a number of different conditions. It gives rise to hypertrophy and dilatation of the stomach which becomes enlarged downwards and forms a sac in which food collects perhaps for days and undergoing fermentative changes is finally ejected in large quantities mixed with frothy mucus and a yeast like scum containing an abundance of *sarcinae*. The stomach may in time almost reach the pelvis the pylorus being dragged down with it.

The causes of this condition are as follows (1) Most frequently it is due to the healing of a *gastric ulcer* situated within or close to the pyloric orifice in the acute form where the ulcers are small spasm as a result of the associated hyperchlorhydria is an important element in aggravating the symptoms caused by a slight contraction. The treatment in these cases is at first medical and includes daily lavage of the organ. Should it fail to give relief operation is required and consists in excision of the pylorus or in gastro enterostomy. (2) It may result from the contraction of *extrinsic adhesions*. These may be massive or band like in the former case the pylorus is embedded in the newly formed fibrous tissue in the latter it is linked and subsequently contracted. Such adhesions may be secondary to gastric ulcer or may arise from an inflamed gall bladder (pericholecystitis). Operative treatment is usually necessary in order to divide the adhesions or to remedy the condition by gastro enterostomy. (3) It may be met with as a **congenital hypertrophy** of the pylorus in which the overgrowth chiefly involves the muscular fibres and is probably due to pre natal hyperadrenalism associated with the irritation of phimosis. It usually occurs in male children and the pylorus is transformed into a solid cylindrical mass about an inch in length pale in colour and sometimes as hard as cartilage (Fig 708). It may be difficult to palpate as it often lies deeply behind the liver but its recognition is the only certain diagnostic sign it is usually placed just outside the right rectus muscle in the transpyloric plane. Symptoms commence within two or three weeks of birth after taking food there is not much evidence of pain although the child may appear to be uncomfortable and relief is obtained by vomiting of a projectile type. But little food appears to pass into the intestine so that constipation is marked and the child soon wastes. The stomach

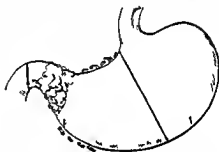


FIG. 07.—CANCER OF PYLORUS INDICATING THE SITUATION OF THE LYMPHATIC GLANDS ALONG THE TWO CURVATURES AND OF THE INCISIONS NEEDED TO INCLUDE THE I

becomes enlarged after a time with visible peristalsis. *Treatment*—Medical measures such as lavage and dieting can obviously only be of use during the stage when a diagnosis has not been reached, after this the only rational treatment is surgery, and that is now limited to *Rammstedt's operation*. The pylorus is brought to the surface through a short right paramedian incision about $1\frac{1}{2}$ inches in length. Steadied by the left hand the pyloric sphincter is divided longitudinally throughout its length the incision reaching well on to the stomach where the muscular fibres shade off, but very cautiously towards the duodenal end where the fibres end abruptly, and the mucous membrane may project and is liable to be wounded. The incision lies as near the continuation of the lesser curve as possible, *i.e.* well back. When complete, the mucous membrane projects into the gap as a hernial protrusion and is left in that condition. Bleeding is unusual, and can be arrested by pressure, and then the pylorus is replaced and the abdominal wall closed. Shock

is likely to be severe and must be suitably combated, the results of the operation are excellent. These patients are nearly always very greatly dehydrated and their chlorides are very low. The mortality can be lessened if an abundant supply of saline solution is given both before and after operation and if the operation is performed under local anaesthesia.

Gastroptosis is a condition met with not very unfrequently in which the stomach is displaced downwards and dilated usually as a complication of general visceroptosis

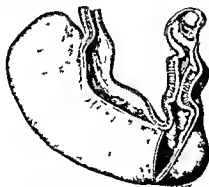


FIG 708—CONGENITAL HYPERTROPHIC STENOSIS OF THE PYLORUS (ROYAL COLLEGE OF SURGEONS MUSEUM)

(Glenard's disease) and hence is likely to be associated with dropping of the liver and mobility of the right kidney. The symptoms produced are those of a chronic atonic gastritis with a dilated stomach vomiting is not a marked sign but acid eructations, gastric discomfort and constipation are very troublesome, and the patient steadily loses weight neurasthenic manifestations are prominent. The downward displacement of the stomach may be so great as to permit the pancreas to be felt above the lesser curvature. Haematemesis is sometimes present but the acidity is normal or diminished, and the diagnosis from gastric ulcer is thereby determined. Radiographic examination after a barium meal assists in determining the extent of the displacement. *Treatment* consists in lavage and electricity to the organ in the first place with careful dieting and external support by a suitable belt is of some value. In more advanced cases operative treatment has been often undertaken, but is of little value.

Acute Dilatation of the Stomach (Fig 709) is a curious condition occasionally met with as an unexpected and unwelcome sequela of injury or operation and that by no means necessarily limited to the abdomen. It sometimes develops without apparent cause in the course of debilitating illnesses. It is characterized by a sudden onset the vomiting of enormous quantities of fluid and severe general symptoms which usually terminate fatally in a few days. The stomach becomes enormously dilated and the walls are more or less paralyzed as peristalsis is rarely evident. The pathology is uncertain but it is possibly due to constriction of the third piece of the duodenum by the superior mesenteric vessels and the root of the mesentery through a downward drag of the intestines. Treatment consists in regular lavage and raising the foot of the bed and in some cases the abdominal decubitus has given relief. Rectal alimentation is required. Surgical treatment is very unlikely to do good unless there is some associated obstruction near the pylorus.

Operations upon the Stomach

1 **Lavage of or Washing out the Stomach** is needed in cases of poisoning in chronic catarrh in dilatation of the organ and as a preliminary to some operations in which the cavity is to be laid open. It may be accomplished by the ordinary stomach pump or by the simpler method of passing a long tube of good sized calibre to the upper end of which is attached a funnel. Fluid is introduced through the funnel and syphoned out by lowering it below the level of the stomach.

2 **Gastrotomy**, or opening the stomach is required for the removal of foreign bodies from it or from the lower end of the œsophagus for exploratory purposes and as a means of dilating simple strictures of the cardiac orifice.

Operation—A median or paramedian incision is made above the umbilicus. The peritoneum is opened and the stomach recognized by its position immediately under the liver and by the thickness, pink colour and opacity of its walls. Gentle traction enables it to be withdrawn and it is opened by a longitudinal incision suitably placed midway between the two curves. The foreign body is removed or other manipulation undertaken and the stomach is subsequently closed by Czerny Lembert sutures.

The *cardiac orifice* is not easily reached as it lies deeply just in front of the aortic opening in the diaphragm. It can be stretched by the fingers or by suitable dilators and a foreign body by this means removed.



FIG 709—ACUTE DILATATION OF THE STOMACH

from the lower end of the œsophagus. The utmost gentleness must be observed in this proceeding as serious symptoms may be caused by irritation or injury of the pneumogastric nerves the terminations of which pass through this opening in the diaphragm.

3 **Gastrostomy** consists in the formation of a permanent artificial opening into the stomach through which the patient can be fed. It is needed in cases of malignant disease or intractable stenosis of the œsophagus. It is most important that the opening should be of a valvular type so that there shall be no escape of gastric juice followed by irritation and digestion of the surrounding skin which were so constantly seen in the old days. The chief methods of operation are those known as Frank's, Witzel's and the Kader Senn procedure the last is perhaps the best and easiest operation.

In the *Kader Senn* operation the tube is inserted into the stomach and stitched in place and then buried by introducing a series of purse-string sutures around the tube including the sero-muscular coats. These are tied one above the other and thereby form a track leading directly down to the site where the viscus has been opened. The stomach is then sutured to the abdominal wall. An excellent fistula is thereby constituted and the results are most satisfactory in the prevention of leakage. It is a simpler operation than the others and probably is preferable to any.

4 **Gastrectomy**—Excision of limited portions of the stomach wall for ulceration or for localized growths is not an uncommon procedure. Its employment in the treatment of chronic ulcers has been already alluded to and the point emphasized that the operation must be so planned as not to cause gross deformity of the organ with a resulting interference with function. Operations with a somewhat wider scope planned on the lines of that for malignant disease will often give better functional results than more conservative measures (Figs 710 and 711). The actual technical detail is similar to that employed in the latter proceeding.

Total excision of the stomach has been undertaken for extensive malignant disease which must however have left unaffected a sufficiency of the œsophageal end to allow of the fixation thereto of a coil of the jejunum brought up over the transverse colon. When however the disease has become so extensive as to need such an operation the ultimate chances of cure are very poor.

Partial Gastrectomy for removal of chronic ulcers or of carcinoma of the pylorus (the so-called *pylorectomy*) is now frequently performed with excellent results in suitable cases. The patient must not be too debilitated and the disease must be to a large extent free from adhesions. Of course the presence of secondary cancerous deposits in the liver or elsewhere renders all chance of cure hopeless but the operation may give great relief to the patient.

Operation—The abdomen is opened through a paramedian incision and the diseased area explored so as to permit a final decision to be made as to the practicability or not of removing it. If an operation is determined on the growth is carefully freed from surrounding parts by dividing the attachments of the great and lesser omenta the lymph

phatic glands being included in the scope of the operation. The duodenum is then divided between clamps by a diathermic cautery the incision in cases of cancer being carried $\frac{3}{4}$ inch beyond the pylorus, and the distal end closed. The clamp on the gastric end is retained and used as a tractor to hold the stomach over to the left side its posterior wall thus presenting (Fig 710). A suitable coil of the jejunum is next drawn up and placed transversely across the stomach (Fig 711) a row of sero-muscular stitches fixes it in position. The stomach is then divided between clamps by knife or thermo-cautery, and the diseased section removed and the jejunum is opened longitudinally. The gastro-jejunostomy is now completed in the usual way.

The chief danger of the operation is shock, but this is easily avoided by careful protection of the viscera by the prevention of hæmorrhage,

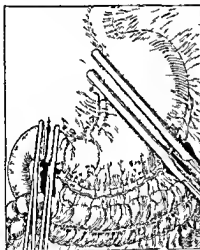


FIG 710—PARTIAL GASTRECTOMY
Clamps applied and the duodenum divided



FIG 711—PARTIAL GASTRECTOMY
The jejunum has been joined to the stomach in front of the transverse colon

and by rapidity of execution, and the actual mortality is very small. The patient is fed *per rectum* for the first forty eight hours if possible, but after that interval small quantities of fluid may be allowed, and the dietary gradually increased.

5 Gastro-enterostomy, or, more correctly gastro jejunostomy, has been largely exploited in the treatment of gastric pyloric, or duodenal lesions and has been so perfected that its mortality is now a negligible quantity. Formerly it was employed for almost all cases of ulceration of the stomach or duodenum where in spite of medical treatment, pain vomiting or hæmorrhage persisted in the hope that by allowing the stomach to empty itself rapidly without passing through the pylorus or duodenum the ulcerated surface might be put at rest and healing

thereby encouraged. In not a few cases where some degree of stenosis existed great benefit followed but in many cases this hope did not materialize and the symptoms persisted or sometimes were aggravated. At the present time there is an increasing effort to deal with the ulcers by excision either local or extending to half the stomach and to limit the employment of a simple gastro-enterostomy (a) to cases of gastric ulcer where definite obstruction is present hindering the onward passage of the food through the pylorus and duodenum and where excision is considered to be unnecessary or undesirable and (b) to duodenal ulcers to supplement or replace local treatment (c) It is also a valuable proceeding in cicatricial and other forms of stenosis involving the pylorus or duodenum and (d) it constitutes the last stage in all cases of excision of any large portion of the stomach for the fixed position of the duodenum makes it impossible to approximate it to the remaining proximal portion of the stomach.

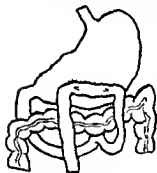


FIG. 12. ANTERIOR GASTRO-ENTEROSTOMY.

Operation—The abdomen is opened by a median or paramedian incision and the stomach is readily found; a careful examination of the parts is made to confirm the necessity for the operation and to select the most favourable site. The anastomosis may be made to either the anterior or posterior wall of the stomach and whilst the latter is in most cases the operation of choice, the former has its advantages and advocates. The gastric opening should be, if possible close to the greater curvature but well away from the growth or ulcer and well to its proximal side. To find the upper end of the jejunum

the transverse colon is withdrawn from the wound together with the omentum. By tracing down the transverse meso-colon to its attachment the termination of the duodenum is reached as it crosses the middle line at the lower border of the pancreas and the coil of bowel which emerges on the left side is necessarily the commencement of the jejunum.

(1) The *anterior* operation (Fig. 712) has to be employed not unfrequently in cases of extensive gastrectomy and some surgeons prefer it always. The objections to it are twofold (a) The jejunum is drawn up over the transverse colon and may possibly constrict it and lead to obstruction this is the more likely to occur when the opening in the jejunum is as near as possible to the duodenum a desirable arrangement from many other points of view and (b) where a longer loop is employed the necessary drag of the gut is apt to bring the two limbs parallel to each other and thus produce a spur or kink by means of which the bile is directed into the stomach instead of into the efferent limb thus establishing a vicious circle. Severe bilious vomiting results which may prove fatal. This can be

obviated by making an additional lateral anastomosis between the afferent and efferent limbs of the loop and the operation is then quite satisfactory. The actual method of anastomosis is similar to that for the posterior operation.

(2) In the *posterior* operation the jejunum is united to the posterior wall of the stomach through an opening in the transverse meso colon the lesser sac of the peritoneum being thereby traversed. The jejunum is identified and brought into apposition with the posterior wall of the stomach in such a manner as to leave no loop between the site of anastomosis and the flexura duodeno jejunalis. The long axis of the new stoma must be oblique so that when the stomach is replaced there shall be no kink of either afferent or efferent loop and the peristaltic wave shall pass freely from the stomach to bowel. If for any reason a long afferent loop is left an additional anastomosis should

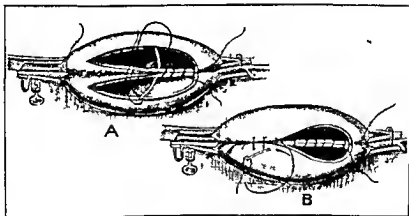


FIG 713 —POSTERIOR GASTRO ENTEROSTOMY

A Introduction of first haemostatic suture after the sero muscular suture is completed B the return haemostatic suture

always be effected between it and the efferent loop so as to guard against vicious circle vomiting.

The actual anastomosis is effected most conveniently by the use of long metallic clamps with or without rubber guards over the blades which are applied to the stomach and intestine in such a way that they can be brought easily into apposition one with the other (Fig 713) and with sufficient force to prevent extravasation of the contents and to control haemorrhage. A suitable protective packing of gauze etc is then made and all other viscera are replaced. Impressed by the possibility of haemorrhage occurring after the removal of the clamps some surgeons have advised that they should be discarded. It is quite a simple matter to operate without them the parts being temporarily fixed by clip forceps on making the incisions every bleeding vessel can be seen and secured but it makes the operation a

little longer and with careful stitching the clamp operation is satisfactorily hæmostatic

The parts having thus been brought into position and the abdominal cavity guarded the first row of sero-muscular sutures is then introduced bringing the posterior aspects of the viscera into apposition. The stomach and bowel are then opened on either side of the first suture line any fluid escaping being received on gauze swabs. The mucous membranes and coats of the stomach and jejunum are next united by a continuous hæmostatic suture. This may be performed in two sections back and front or one suture may suffice for the whole anastomosis. Finally an anterior sero-muscular suture completes the junction to effect this satisfactorily it is often wise to remove the clamps. Occasionally a few extra supporting stitches are required in addition to the two rows and it is well to secure any large vessel going to the site of anastomosis by passing a suture under it and tying it. When clamps are used the suturing must be accurate and close so as to ensure absolute hæmostasis of the divided visceral walls.

The usual peritoneal toilette follows blood is sponged away swabs and strips of gauze are removed and counted the viscera replaced and the abdominal incision is closed.

The *after treatment* consists in the adoption of the sitting posture and in abstaining from stomach feeding for twenty-four to forty-eight hours if practicable rectal or intravenous alimentation being resorted to in the interval. Hæmorrhage from the divided visceral walls is sometimes troublesome the patient vomiting blood-stained fluid. Ice is then applied to the epigastrium and a full dose of ergotin administered hypodermically or 20 grains of lactate of calcium by rectum. Not unfrequently there will be some regurgitation of bile into the stomach and this may lead to troublesome vomiting for a few days but if the junction is satisfactory it soon passes off especially when food is administered by the mouth as may usually be undertaken on the third day or earlier if necessary. At first only fluid nourishment should be permitted but in a week's time soft solids may be given and gradually a more liberal diet is ordered. The effect of the operation is necessarily only palliative when cancer is present but the general condition often improves considerably for a time and the final exitus lethalis is associated with less suffering.

Should serious biliary vomiting occur the patient must sit up and the stomach be washed out. Failing that it may be necessary to open the abdomen and establish a fresh opening between the afferent and efferent coils. To prevent the possibility of such an occurrence Roux has suggested making a Y anastomosis. The jejunum is cut across the lower segment being implanted at right angles into the stomach and the upper or duodenal end into a second opening in the gut lower down. Excellent results have followed.

Peptic Ulceration may occur at the site of anastomosis or a little below it but is uncommon except after the anterior operation and even then only occurs in 2 per cent of the cases and within the first twelve months. It has certainly diminished in frequency since silk has been discarded as a suture material in favour of catgut. It may

determine pain and vomiting after food accompanied perhaps by hæmorrhage or perforation. Treatment must be directed to diminishing the acidity of the gastric juice.

6 **Finney's Operation**, or gastro duodenostomy, is employed by some surgeons as an alternative to gastro jejunostomy. It consists in an anastomosis between the second piece of the duodenum and the immediately adjacent stomach. It has its advocates, but has not come into general favour.

Ulcers of the Duodenum are very similar in nature and origin to those of the stomach, to which indeed they may be secondary. They occur most frequently in men thirty or forty years of age, and often without any obvious cause. Oral sepsis is not uncommonly present, as also hyperchlorhydria, in some cases chronic nephritis or arteriosclerosis has existed, and in others the lesion follows some operation. The first part of the duodenum is that almost invariably affected, and the anterior rather than the posterior wall, the character of the ulcer is similar to that seen in the stomach. The ulceration which forms a very occasional sequela of burns has been already alluded to, and is quite a distinct type.

The **Symptoms** are tolerably characteristic, even apart from the dangerous complications, hæmorrhage, perforation, and stenosis. The patient, who may appear to be fairly well nourished, complains of pain coming on after meals not immediately, but after an interval of two or three hours, and often relieved by taking more food. Beginning with a sense of fulness and heat in the epigastrium, it develops into acute pain located in the right hypochondrium and shooting through to the back. On examination of the abdomen a tender spot is usually to be detected a little above and to the right of the umbilicus. The patient complains much of acid eructations, but vomiting is not a very frequent symptom, when present, it may relieve the pain. The ejecta may contain a certain proportion of bile. The patient is constipated, and loses weight during an attack. Frequently he has intervals of complete freedom from pain, in which he can digest anything and enjoy life. In a considerable percentage of cases, moreover, the condition is absolutely latent and free from symptoms until acute manifestations of perforation or hæmorrhage supervene.

Perforation usually involves the first part of the duodenum, and may be intra- or retro peritoneal. The conditions produced are practically identical with those following a perforated gastric ulcer, but with slight differences due to the change of situation. Thus, with the usual acute intraperitoneal perforation the fluid on escaping from the duodenum is guided downwards by the ascending meso-colon to the right iliac fossa, and hence the symptoms of acute appendicitis are sometimes simulated, but it may be possible to locate the primary pain to the hypochondrium. The mischief soon spreads, however, to the general cavity, and the localizing symptoms disappear. The effusion includes the fluid duodenal contents, often very abundant and perhaps bile-stained, and usually free gas. If the opening in the duodenum is small and the contents escape slowly, a subphrenic or

subhepatic abscess may form to the right side of the falciform ligament but the adhesions are not very firm and it may burst secondarily into the general serous cavity. A retroperitoneal perforation of the duodenum is the origin of a subphrenic abscess which is placed behind the peritoneal cavity.

Hæmorrhage may be so slight as only to be recognized by careful examination of the *fæces* or it may be more abundant giving rise either to hæmatemesis or obvious *melæna*. The history generally given is that during a dyspeptic attack a sensation of faintness occurs followed by anæmia. Part of the blood lost may be vomited but the greater portion passes down the intestine giving rise to *melæna*. The



FIG. 714.—SKIAGRAM OF A CASE OF DUODENAL ULCER.

The ulcer crater is seen as a barium filled excrescence on the inner border of the first part of the duodenum radiologically termed the cap or bulb. The inner border and the outer border show general deformity owing to associated scarring and spasm. (Confirmed by operation.)

patient may die from loss of blood and then usually some large branch of the pancreatico-duodenal vessels has been laid open more frequently it ceases after a time but may be repeated again and again. Duodenal hæmorrhage is to be looked on as more dangerous than bleeding from the stomach and the mortality is certainly higher. Prevention by operative treatment in an earlier stage is not only justifiable but desirable.

Stenosis of the duodenum results from the cicatrization of ulcers and may lead to frequently repeated vomiting dyspepsia of an intractable type a greatly dilated stomach and emaciation to an alarming degree.

The diagnosis of a duodenal ulcer is often assisted by radiography in early cases the food passes out of the stomach and through the duodenum all too quickly in the later stages delay in the duodenum or irregularity of the duodenal cap can be seen (Figs 714 and 715) Not unfrequently the actual site of the ulcer can be localized some hours after the meal has been given by a persistence of some of the barium in the hollow of the ulcer after the bulk of it has passed into the intestine



FIG 715.—SKIAGRAM OF A CASE OF DUODENAL ULCER

The cap is constricted by spasm into a typical trefoil shape. The ulcer which is on the posterior wall and therefore covered by the barium in the cap can just be distinguished in the radiogram as a spot of increased barium density in the outer part of the inner leaf. On screening the remainder of the barium could be expressed from the cap and the fleck of barium residual in the ulcer crater seen. (Confirmed by operation.)

Treatment—When a diagnosis has been made and no complications are present the same treatment is instituted as for gastric ulcer *viz* rest in bed and rectal alimentation. Persistence or recurrence of symptoms makes operative treatment justifiable and desirable with the view of preventing the development of complications which may prove fatal. On the other hand a duodenal ulcer differs from a gastric in that it never undergoes malignant change and this observation

controls to some extent the surgical measures required for its treatment. Unless complications are present it usually suffices to constrict the pylorus by a purse-string sero muscular suture and to perform posterior gastrojejunostomy this puts the part at rest and healing follows quickly. *Hæmorrhage* may possibly be dealt with locally by excision of the ulcer or if this be impossible by ligature or cautery. The anterior wall can also be crowded down by suture against the posterior so as to exercise pressure and a posterior gastro-enterostomy performed. In duodenal hæmorrhage time must not be wasted in preliminary medical treatment.

Perforation of course needs immediate operation as described for the stomach. The opening when found should be stitched up and if necessary an omental graft can be placed over it and finally if the patient's condition warrants it a gastro-enterostomy is performed. Of course the same operation is required in all cases of *stenosis* there are few operations in surgery that give more gratifying results than this procedure in a case where the patient has been practically starved for years from this cause.

Affections of the Intestine

Radiography of the intestines is often of great assistance in the diagnosis of the condition and position of various lesions. As already mentioned the stomach should be empty in about four hours and about the same time (four and a half hours) the barium should begin to enter the cæcum it is not usually possible to trace the barium in the duodenum or along the small intestine. There is not uncommonly some hindrance to the escape of barium through the ileo-cæcal valve and it may collect in the lower end of the ileum and be seen in the pelvis. The hepatic flexure is generally reached in five to eight hours the splenic flexure in seven to fourteen hours and the iliac colon in eight to sixteen hours the barium normally disappears from the bowel in from twenty four to thirty six hours. Irregularities in the course of the intestine can often be detected by this means such as strictures kinks diverticula etc. The appendix can occasionally be recognized and difficulty in the escape of the barium from the small to the large intestine may suggest the existence of adhesions binding down the appendix. Too much stress must not be laid on radiographic reports apart from a careful consideration of the clinical phenomena. Barium is heavy and a downward displacement of the intestine when loaded with it is a natural consequence it is also somewhat astringent in type and determines contraction of the intestinal wall so that the diverticula of the colon become exaggerated. Finally it must ever be remembered that radiographs are shadow pictures and unless taken stereoscopically it is possible to imagine the existence of severe kinks due to the overlapping of the shadows when in reality nothing of this type is present this warning especially needs emphasis in reference to the interpretation of radiographic representations of the flexures of the colon.

Congenital Conditions are occasionally met with affecting the intes

tine and perhaps giving rise to serious complications (a) The most common of these consists in what is known as *Meckel's diverticulum* (Fig 716) which occurs as an outgrowth from the lower end of the ileum. It may be patent for 1 or 2 inches terminating possibly in a fibrous cord which floats free among the intestines or may contract adhesions and thus determine an internal strangulation sometimes it persists as an open tube as far as the umbilicus giving rise to a congenital faecal fistula. It is due to non obliteration of the omphalo-mesenteric duct. Many forms of acute abdominal trouble have been caused by this structure and even inflammatory attacks similar to acute appendicitis gall stones or enteroliths have lodged within it and caused perforative peritonitis (b) *Congenital stenosis* of the duodenum occurs at the junction of the fore- and mid gut i.e. opposite the entrance to the common bile duct and a similar condition may

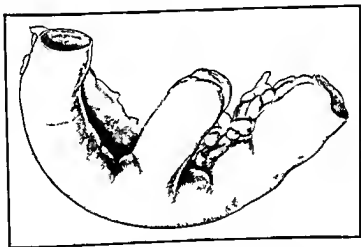


FIG 716 —MECKEL'S DIVERTICULUM

arise in the lower part of the ileum at a spot corresponding to the site of Meckel's diverticulum (c) Diverticula may be met with in any part of the small intestine they are usually discovered during X ray examination. When occurring in the duodenum they may give rise to symptoms suggesting ulceration (Fig 717)

Contusion of the Intestine may result from any serious blow on the abdomen and necessarily varies in its effects with the nature and force of the injury the amount of distension of the gut and the strength and power of resistance of the parietes. In its simplest form it merely produces a little bruising of the intestinal wall followed by a subacute or chronic enteritis from which with care the patient quickly recovers. In the more severe cases an acute enteritis ensues due to bacillary invasion which may even run on to ulceration or sloughing especially if the mesentery has also been involved in the injury. Under these circumstances the final issue depends largely upon the rapidity of the

inflammatory process. If adhesions have had time to form between the parietes and the injured gut, the mischief is limited, and the patient may recover with a fecal fistula, the formation of which has been preceded by a localized intraperitoneal abscess. If however, the inflammatory affection is more rapid in its onset acute diffuse peritonitis is almost certain to follow. When the injured portion of the bowel is retroperitoneal as in the duodenum or colon, a retroperitoneal abscess may form.



FIG. 117.—DIVERTICULUM OF DUODENUM WITH DIVERTICULOSIS OF COLON

Note the rounded shadow in the second part of the duodenum and also the extraluminal shadows due to diverticula projecting from the transverse colon. This skiagraph was taken after a second barium meal given when the transverse colon was full in order to show the two conditions together.

The Symptoms of intestinal contusion consist primarily of shock and pain. The amount of shock varies necessarily with the severity of the injury and the nervous susceptibility of the patient. The pain may not be severe at first, but is always very marked subsequently and increased by examination, movement, or during violent respiratory effects. To limit such movement, the abdominal parietes are maintained in a state of firm contraction, and can be felt hard and resistant. Vomiting may be present but is not a marked feature. The later symptoms necessarily vary with the course taken by the case and need not be described in further detail.

Treatment is conducted along the same lines as that of contusions of the abdominal wall if where there is no absolute evidence of rupture an expectant attitude may be adopted but the surgeon must be ready to interfere immediately should any grave or suspicious symptoms arise. Acute enteritis induces diarrhoea and the passage of blood stained mucus and such symptoms will indicate the use of bismuth and perhaps a little morphine whilst a fluid diet or rectal feeding is alone permissible.

Rupture of the Intestine follows abdominal injuries of a more severe character such as when a cart or cab has traversed the abdomen or when the patient has been tightly squeezed or kicked. The bowel does not always give way at the point of impact but occasionally at a distance from it under these circumstances the tear is more likely to be ragged and irregular whilst if it yields at the point struck the gut may be cleanly torn across. The parts most frequently affected by this form of injury are the junction of the movable jejunum with the fixed duodenum and the lower 3 feet of the ileum. The fluidity of the contents of the small intestine has a grave prognostic significance since they are readily diffused.

The early symptoms consist of severe and usually lasting shock accompanied by intense abdominal pain which may at first be localized. If there is an abundant escape of the intestinal contents a virulent form of acute peritonitis follows immediately from which the patient rapidly succumbs. If however the gut was empty at the time of the accident the symptoms are less severe acute peritonitis ensues but it is slower in onset and some attempt to limit it is observed. An important diagnostic point is that the maximum tenderness is always fixed to a localized area. Free gas is sometimes but not frequently present in the peritoneal cavity as in rupture of the stomach. In a few cases emphysema of the abdominal walls has been noted and in the absence of thoracic injuries or of diffuse cellulitis is an absolutely certain sign of rupture of the intestinal tube. Vomiting occurs but not to an excessive degree if blood is found in the vomit it suggests that either the stomach or upper part of the intestinal canal has been injured. Occasionally a blood stained motion is passed but only late in the case.

The Diagnosis of a ruptured intestine is always a matter of uncertainty in the absence of emphysema of the abdominal walls which is very uncommon. Free air or gas in the peritoneal cavity would be an absolutely diagnostic sign if it could be recognized with certainty. It does not however find its way to the under side of the anterior abdominal wall or even between the liver and diaphragm as was formerly supposed thereby leading to a reduction in the hepatic dulness but is usually hidden under the diaphragm and is unrecognizable. Radiography is often of great assistance in the diagnosis of these cases. Apart from this the general features of the case must be considered. Shock is also an uncertain guide as it varies both in degree and duration. The temperature does not help much although a secondary fall below normal after reaction especially if associated with increasing rapidity of pulse and respiration is very suggestive

of grave mischief. An area of deep *fixed* tenderness and pain, with, perhaps a rigid retracted abdominal wall over it, and the incidence of early acute peritonitis, are probably the only signs that we can depend upon with any certainty. The history and nature of the accident are important, and should be carefully considered.

In the non existence of any distinct signs of rupture, Treatment in the early stages can only be expectant, and directed towards combating shock and relieving pain. A small dose of opium should be administered with this object, as also to check peristalsis and hinder further extravasation of the intestinal contents, but as little as possible should be given, since it tends to mask symptoms. If the surgeon suspects that the intestine is torn, he ought at once to undertake an exploratory operation.

Punctures or Stabs involving the intestine lead to a similar series of phenomena, but the diagnosis may be easier, as gas or faecal material may escape through the external wound. The direction of the incision in the gut is of importance, since a longitudinal cut (running parallel to the axis of the bowel) is more likely to gape than a transverse one, owing to the greater power of the circular muscle fibres, a small puncture may be almost closed by a protrusion of mucous membrane. Shock is not necessarily so severe as in cases of rupture by violence without penetration, abdominal pain is always present, and acute peritonitis quickly follows.

Treatment—Every wound of the abdominal wall where penetration is suspected should be carefully explored. If the peritoneum is not opened, the different layers of the abdominal wall are sutured together. If the peritoneum has been involved, the opening in it should be enlarged, so as to determine with certainty whether or not the gut has been wounded. If a small punctured or incised wound of the intestine is present, it is invaginated and closed, if a more extensive lesion exists, excision of the damaged portion may be necessary, but if the patient is deeply collapsed from the supervention of peritonitis, it may be wiser to bring the divided ends to the abdominal wall, and form a temporary fistula, which is dealt with when the patient's general condition has improved. As to the treatment of the resulting peritonitis, the reader is referred to what has been written concerning rupture of the stomach.

Perforation of the Intestine arises from many different causes, such as the impaction of a foreign body, or the yielding of an intestinal ulcer as in tuberculous disease or typhoid fever, or from that form of enteritis which follows strangulated hernia. Perforation of an ulcer of the stomach or duodenum has been already discussed, and perforation of the appendix will be alluded to subsequently (p. 1218).

When the jejunum or upper portion of the ileum is involved, perforation is usually due to the impaction of a foreign body, such as a fish bone, or to yielding of a tuberculous ulcer. In the former case general peritonitis is almost certain to follow, but in tuberculous cases the lesion is of a more chronic type, and then adhesions may form, allowing an intraperitoneal abscess to develop, and should it open externally, a faecal fistula results. In not a few cases the process of

cicatrization may lead to a spontaneous closure of the fistula, and no operation should be undertaken until sufficient time has elapsed to determine whether or not this will occur

In the lower portion of the ileum, *typhoid fever* is the most usual cause of perforation. Occasionally in cases of the so-called 'ambulatory typhoid' it is the first evidence of the presence of the disease, but it generally occurs about the end of the second or in the third week, and rarely more than one perforation is present. It is most commonly seen in bad cases associated with meteorism and hæmorrhage but is not limited to these. The symptoms are usually those of sudden collapse, as indicated by a falling temperature and a quick and feeble pulse, whilst severe and persistent abdominal pain followed by increasing distension indicates the development of general peritonitis. Even when the patient is already collapsed by the disease, some slight fall of temperature with acceleration of the pulse may occur, associated with abdominal pain and meteorism. Early rigidity of the belly wall is an important diagnostic sign, whilst there may be some irritability of the bladder. The only treatment which holds out any prospect of saving the patient is operation, but owing to his depressed condition the outlook is not particularly bright. Obviously, when he is moribund, it is useless to interfere, but the fact that the death rate after operation has gradually fallen from 90 to 60 per cent indicates that in cases diagnosed early a fair proportion of success may be anticipated. The abdomen should be opened in the middle line below the umbilicus, or directly into the right iliac fossa, and if the lesion is not at once obvious, the ileum is sought for at its junction with the cæcum, and the bowel brought up and carefully examined inch by inch till the perforation is found; it may then be closed by sutures introduced so as to close the wound in the transverse axis of the gut. The peritoneum is cleansed and drained in the usual way, after determining that no second perforation is present or imminent.

In the large intestine the most common cause of perforation is ulceration due to diverticulitis, chronic obstruction, or malignant disease. In many cases acute perforative peritonitis follows, but occasionally the mischief is limited and an intraperitoneal abscess forms, followed by a faecal fistula.

Foreign Bodies in the intestine are of three types

1. *Gall stones* give rise to no symptoms unless they are of large size, the smaller ones enter the canal through the common bile-duct after an attack of biliary colic and are voided in the stools. Larger stones usually gain entrance to the intestine by ulceration from the gall bladder into the duodenum. A coating of faecal matter is likely to form around them, and thus they increase in size as they pass downwards, whilst the intestine gradually diminishes in calibre from the duodenum to the ileum so that they are likely to become impacted in the lower ileum (Fig 718). Women over fifty are most often the subjects of this condition, and there may be only a history of some inflammatory condition of the region of the gall bladder, and none of biliary colic.

2. *Enteroliths* are of three classes (a) Calculi of phosphate of lime

or inspissated faeces form around some foreign body as a nucleus. (b) Masses of indigestible vegetable material may be matted together with inspissated faeces, mucus, etc., they are said to be not uncommon in Scotland (the so-called *arenoliths*), consisting largely of the husks of coarse oatmeal. They have also been known to consist of hair, or of cocoanut fibre in a patient engaged in mat making. (c) Calculi have been found consisting of insoluble mineral salts e.g. phosphate or carbonate of magnesia or calcium salol, etc., taken as medicine. Whatever their origin, such enteroliths are likely to become impacted near the caecum, and may cause acute obstruction. In thin persons their presence may sometimes be detected by palpation of the abdomen.

3 *Foreign Bodies accidentally or intentionally swallowed* occasionally pass through the stomach and become lodged in the intestinal canal. Lunatics and children are most frequently affected, and in the former the most astonishing collections are occasionally found.



FIG 718—TWO LARGE GALL STONES WHICH ULCERATED INTO THE DUDENUM AND CAUSED INTESTINAL OBSTRUCTION

The Symptoms caused by such conditions will be either those of intestinal obstruction or of perforation. In the latter the process is usually gradual, rather than sudden, giving time for adhesions to form, thereby limiting the mischief. Suppuration follows, and possibly the foreign body may be extruded naturally or removed by the surgeon through the abscess cavity, with or without the formation of a fecal fistula.

Small spiculated foreign bodies, e.g. fragments of glass or metal,

the husks of cereals etc., may sometimes lodge in the pouches of the colon, and give rise to localized inflammatory phenomena (see on diverticulitis p 1185)

Enteritis, or inflammation of the mucous membrane of the intestine, is a condition usually treated by the physician, occasionally it complicates surgical cases and needs suitable treatment. Thus it may follow the exposure of a coil of intestine in the depths of a wound which has to be packed for drainage purposes. Severe diarrhoea may result, and the inflammation may even spread through the whole thickness of the gut wall and lead to the establishment of a fecal fistula. Enteritis also occurs as a post operative complication of strangulated hernia. Whatever its origin, it is always characterized by diarrhoea of varying type and by pain or abdominal discomfort and perhaps vomiting. *Treatment* consists in the use of a bland diet, e.g. milk, and the administration of soothing astringent drugs such as bismuth and perhaps opium. It must not, however, be checked without ascertaining so far as possible that the causative irritant has been removed and not uncommonly the best treatment to start with is the administration of a good dose of castor oil.

Colitis is an affection occasionally needing surgical treatment. The cause is usually chronic constipation, but bacteria of various types or the *Entamoeba coli* may be present. In the simpler cases (mucos-membranous colitis) the patient complains of griping pains in the course of the colon, diarrhoea, the passage of mucus in the stools, perhaps in membranous flakes or rolled up into strings, and definite tenderness of the colon on palpation. The appendix is not unfrequently inflamed at the same time, and one of the most tender spots may be over this organ, it is possible that in a few cases it constitutes the nidus in which develop the organisms that cause the trouble. Treatment of this form consists in emptying the bowel by enemata, keeping the patient quiet in bed on a milk diet, and possibly ordering bismuth or a little chlorodyne. When the patient is convalescent and all tenderness has disappeared, the causative chronic constipation must be treated. Purgatives usually cause irritation and pain, and must be avoided as far as possible, but paraffin is useful. Abdominal massage and the methodical use of remedial exercises to increase the power of the abdominal muscles, and thereby give tone to the relaxed colon, will often work wonders in these cases. The use of medicinal waters and irrigation of the colon, as practised at Bath Harrogate and Plombières, often give excellent results. In a certain percentage of cases removal of the appendix does good in colitis but the surgeon must not promise too much.

The graver cases (ulcerative colitis) are associated with the discharge of pus and the exfoliation of patches of mucous membrane. The patient's health may be profoundly affected in this disease pus of a most offensive type pouring out from the rectum, or fever of a marked hectic character being present. The nutrition is necessarily impaired, and the patient wastes to a shadow. Under such circumstances, and especially when rectal irrigation has failed the surgeon may be asked to undertake a *cæcostomy* in order to permit of more thorough irrigation and also perhaps to divert the intestinal contents. For the method of operating see p. 1208. The fluid employed for irrigation must be bland, non toxic, and unirritating. Warm saline solution should be first used and subsequently a weak boric acid solution, or possibly, with great care, a 1 in 5 000 solution of nitrate of silver. The patient sits over a bed pan, and the fluid is injected through the fistula from an irrigator, distension of the bowel must be avoided, and to this end the introduction of a rectal speculum to keep the anus open during the irrigation is desirable. *Appendicostomy* has also been used for this purpose, the escape of intestinal contents is less than if the cæcum itself is opened, and subsequent closure of the fistula after the disease is cured is more easily effected. It is probable that some amount of stenosis of the bowel may result from the cicatrization of the ulcers in the colon, and then further treatment may be required.

Diverticulitis (Syn. *Pericolitis*, *Sigmoiditis*, *Sacculitis*, etc.)—Under this title is described an inflammatory condition arising in connection with the secondary, acquired multiple, false diverticula of the large bowel particularly and nearly always found in the sigmoid flexure. They are situated usually in rows, often projecting into the appendices

epiploicæ (Fig 719) Though occasionally found in the cæcum and appendix they are most commonly situated in the descending and pelvic portions of the colon. At first they are merely semi globular pouches consisting of all the intestinal coats but later the muscle fibres atrophy and the pouches become more flask shaped with a definite neck but rarely are larger than a hazel nut. It is possible that they are associated with some congenital weakness of the wall but frequently stenosis or constipation is present leading to increased intra intestinal pressure. Faecal material enters and may become inspissated so as to constitute an enterolith foreign bodies may find

lodgment and thus the basis of a whole series of pathological phenomena very similar to those of appendicitis is laid. Acute inflammation occurs leading to ulceration gangrene or perforation followed by acute local or general peritonitis abscesses may develop opening externally or into some viscus e.g. the bladder and leading to fecal fistule. In other cases chronic inflammatory hyperplasia results giving rise to the formation of a mass resembling a carcinomatous tumour and ending in stenosis. Carcinoma itself is an unfrequent sequela.

The Symptoms of acute diverticulitis usually occur in those who have passed middle life and is twice as common in men as in women. The patients are often fat and well nourished and there is a history of preceding constipation. The symptoms closely resemble those of appendicitis and indeed the term left sided appendicitis has been applied to it. The sigmoid flexure is usually involved and then the site of maximum tenderness may correspond to McBurney's spot on the left side. The symptoms of abscess formation and peritonitis have no peculiar features. In the more chronic cases the development of



FIG 719. LARGE INTESTINE SHOWING A NUMBER OF DIVERTICULA. (KING'S COLLEGE HOSPITAL MUSEUM)

a tumour like mass is the most marked feature lying over the left side of the pelvic brim. It is very likely to be mistaken for a cancerous growth and indeed it is probable that most of the reported cases of the disappearance of a supposed intestinal cancer after operation of an exploratory type where excision was not performed were of this nature. The points of differential diagnosis are that in diverticulitis the patient is generally in good health and indeed tends towards obesity. The history is of some duration and points to recurring slight inflammatory attacks in the left lower quadrant of the abdomen with absence of blood in the stools. Radiography is of assistance in that the characteristic features of cancer are absent and it is often possible to demonstrate the presence of diverticula (Plate XXII)

PLATE XXII



DIVERTICULA OF THE COLON

Treatment—In the *pre inflammatory* stage (the so called *diverticulosis*) treatment must be directed to cleansing the intestine by douches to protecting the mucous membrane by administering liquid paraffin and to preventing the admission of irritating ingesta. Abdominal massage is avoided as it might cause rupture of a weakened spot. In the *acute* stage treatment is akin to that for acute appendicitis; abscesses are opened and drained and the communication with the colon will then often close of itself by granulation. Excision of the affected portion of the colon is desirable but whether it would be wise to attempt it at this stage is very questionable. For the chronic hyperplastic type excision is the only effective treatment followed by end-to-end or lateral anastomosis in a few cases a permanent colostomy has to be established. The existence of fistulous communications with the bladder is no contra indication to operation if the sigmoid is set free it is not a difficult task to close the vesical opening and the result is likely to be satisfactory.

Tuberculous Disease of the Intestine usually occurs in the ileo caecal region and manifests itself in two main varieties

1 **Tuberculous Ulcers** are generally multiple though occasionally single. They are of the usual tuberculous type with undermined margins and extend along the course of the blood vessels and lymphatics *viz* around the gut so that if they heal stricture is almost certain to follow. In their early stages they are seldom seen by the surgeon but later on obstructive phenomena may supervene and these may be due not only to the stenosis but also to associated peritonitis. Neighbouring mesenteric glands are usually infected and together with the bowel and omentum may form a palpable mass in the midst of which suppuration may occur. Should the abscess burst externally a faecal fistula may result. Operation may be needed for the relief of the obstructive phenomena or for the suppuration and some form of anastomosis or even excision of the mass may be required.

2 The disease is sometimes of a hyperplastic type and is then chiefly limited to the caecum producing a well marked tumour which can be palpated from outside known as the **Tuberculous Caecal Tumour**. The disease is liable to extend along the ascending colon for some distance and less frequently along the ileum. The intestinal wall is thick congested and infiltrated with a tuberculous deposit the outer coat is rough and nodulated the mucous lining is ulcerated and often presents vegetations and polypi of a granulomatous type the mass is firm but not hard to the touch. Enlarged glands are found in the mesentery and along the inner border of the ascending colon. Adhesions may be present and lead to kinking or twisting of loops of bowel. In the early stages constipation and diarrhoea may alternate but later on obstructive phenomena may supervene or even well marked pyrexia of a hectic type. The diagnosis from a caecal carcinoma is not always easy the chief points in favour of tubercle are the earlier age (under forty years) the longer duration of symptoms (two or three years) the associated pyrexia and the presence of tuberculous lesions elsewhere. The diagnosis is however not uncommonly made on the

operating table *Treatment*—Prior to operation sanatorium treatment combined with local and general heliotherapy should be employed but if the patient does not react satisfactorily and quickly operation must not be delayed. Removal of the cæcum together with the lower end of the ileum the ascending colon and such glands as are readily accessible is undertaken along similar lines as for cancer and an anastomosis established between the ileum and transverse colon. The results are usually most satisfactory. If for any reason this procedure is impracticable the disease may be short-circuited and good results may be expected to follow.

Regional Ileitis or Crohn's Disease—This is a chronic thickening of the ileum which occurs more frequently in the terminal portion than elsewhere multiple lesions may be present. The condition occurs in young adults who come under observation because of wasting and chronic intestinal obstruction in which intermittent vomiting plays a part. The condition may or may not be diagnosed by X rays but is quite obvious at operation. The affected portion of the gut is very thickened so much so that it cannot be moulded. Excision and anastomosis is required in some cases multiple excisions are necessary. The results of excision are very satisfactory and many complete cures are published. The histological picture shows chronic inflammation of the mucosal submucosal and muscular layers. There may be small ulcers in the mucous membrane and even small abscesses in the submucosa or muscle coats. Although the condition is very similar to tuberculous lesions found at the ileo-cæcal junction in many cases there is no evidence whatever of tuberculous infection and the condition may be looked upon as the hyperplastic response to an unknown infection producing a non specific granuloma.

For Actinomycosis of the Cæcum see p 1279

Stenosis of the Intestine arises from two main causes—the contraction of cicatrices or adhesions and the development of tumours usually malignant.

Simple cicatricial stricture results (1) from the healing of ulcers which have extended more or less circularly around the bowel hence tuberculous ulcers lend themselves to its development more than the typhoid lesion. Syphilitic ulceration is followed by it especially when involving the rectum but the upper part of the jejunum is also occasionally affected. In the large intestine dysentery is the most common cause and the stenosis like the ulceration may be irregular and extensive. (2) It may follow strangulated hernia as the result of ulceration along the actual site of constriction and similarly it may develop after the separation of an intussusception. (3) An end-to-end anastomosis of the gut may lead to stenosis unless care is taken not to encroach too much on the lumen. (4) The contraction of adhesions outside the intestine is by no means an uncommon cause thus it may be due to many forms of localized peritonitis and frequently ensues after pelvic cellulitis.

Since the contents of the *small* intestine are of a somewhat fluid nature a stricture often exists here for some time before any symptoms of urgency arise. The patient may complain of a certain amount of

indigestion and discomfort but sooner or later the narrow aperture of the gut becomes blocked either by a fold of mucous membrane or by a portion of undigested food and thus an attack of obstruction is induced. In the early stages of the disease this can be remedied by purgatives but each recurrence is likely to increase in severity until finally an acute attack supervenes which kills the patient unless relieved by prompt surgical interference.

In the *large* intestine very similar phenomena appear but the attacks of obstruction are of a somewhat different character since there is less pain and vomiting and aperients instead of relieving the patient as they often do in the small gut always aggravate the symptoms. There is also much greater distension of the abdomen. Radiography may determine the diagnosis in a certain number of cases and the sigmoidoscope will be of assistance for the lower foot or more of the bowel, otherwise the nature of the case though strongly suggested by the symptoms can only be actually settled by an exploratory operation.



FIG 720—LIPOMA OF THE JEJUNUM WHICH CAUSED AN INTUSSUSCEPTION

The Treatment in the earlier stages consists of suitable dieting and the administration of purgatives or of large enemata and for a time this will be successful. Sooner or later however a more than usually serious attack of obstruction will call for something more radical and readers are referred to the chapter on obstruction for details of the treatment to be adopted. Apart from the question of obstruction a stricture of the small intestine is to be treated by enterectomy. For stricture of the cæcum or ascending colon some short circuiting method whereby the ileum is implanted into the colon below the stricture (ileo-colostomy) is perhaps the best plan to adopt in the transverse colon excision is sometimes possible as also in the sigmoid flexure. Failing these measures the establishment of an artificial anus will be required.

Tumours of the Intestinal Wall may be simple or malignant, primary or secondary. *Simple* tumours are unusual, and consist of papillary polyp, adenoma, myoma, lipoma and a few other varieties (Fig 720). They may cause irritation and irregular action of the gut resulting perchance in intussusception, hæmorrhage sometimes of a serious character, is associated with multiple papilloma or adenoma and obstruction occasionally ensues. It is unusual for a diagnosis to be made apart from an exploratory laparotomy, unless the rectum is affected. The treatment is governed by the location of the growth and by the symptoms it causes.

Sarcoma of the intestine is not common, it may involve the ileum

or cæcum and give rise to a localized tumour or diffuse infiltration. Obstruction may ensue or considerable peritoneal irritation resulting in an abundant blood-stained exudate which leads to abdominal distension and may be recognized as due to a new growth on tapping. *Treatment* consists in removal of the affected coil of gut if the disease has not progressed too far.

Carcinoma of the Small Intestine is an uncommon condition and represents only 0.5 per cent of all carcinomata of the gastro-intestinal tract from the cardiac end of the stomach down to and including the rectum. These tumours are usually situated in the duodenum or jejunum and may develop either as a secondary change in a papilloma

or as an adeno-carcinoma arising from a solitary polypus. In the past these tumours were rarely diagnosed except after operation for some urgent symptom but to-day with the use of modern X-ray equipment more cases are diagnosed prior to operation. The growth is commonly annular (Fig 721) due to lymphatic spread and gives rise to colicky pain and occult blood may be found in the stools. Anæmia is often very marked when the patient comes under the observation of the surgeon.

Excision of the growth with side-to-side anastomosis is often quite an easy operation. Remote secondary deposits in the mesentery and the liver are rare probably because the growth gives rise to symptoms before such dissemination takes place.

Carcinoma of the Colon is a condition essentially suited for surgical treatment. All other forms of treatment are very unsatisfactory, and



FIG. 21.—CARCINOMA OF THE TERMINAL ILEUM JUST PROXIMAL TO A SMALL MECKEL'S DIVERTICULUM.

cannot be said to bring about a cure of the disease. In the vast majority of cases the tumours are of slow growth and metastasize late being adeno-carcinomatous in histological appearance (Fig 722). It may be said that the actual size of the tumour bears if anything an inverse relationship to its malignancy. The physical characters of the tumour vary considerably but usually conform to one of two types viz (1) the hypertrophic in which a large mass forms perhaps occupying the whole lumen of the bowel (2) the sclerosing form which most often involves the transverse or sigmoid colon (Fig 723). The majority of cases occur in the sigmoid colon and in a series of cases operated upon by one of the authors* during the years 1915-1935 sixty occurred

* Cecil P. G. Wakeley *Med. Press and Circ.* March 4, 1936

in this part of the gut The following table gives the site of the growth and the percentage mortality in this series of cases

PARTS OF BOWEL INVOLVED (1915-1935)

<i>Part of Bowel</i>	<i>Cases</i>	<i>Death</i>	<i>Percentage</i>
Cæcum	30	4	13.3
Ascending colon	4		50.0
Hepatic flexure	3	0	0
Transverse colon	18	1	5.5
Splenic flexure	10	2	20.0
Descending colon	6	2	33.3
Sigmoid colon	60	10	16.6
Totals	131	21	16.01

Crystallization of thought has taken place with regard to the treatment of colonic carcinoma and it is universally agreed that one-stage operations are a thing of the past and that a successful issue will only ensue by decompressing the bowel followed by adequate pre-operative measures before the resection of growth takes place.

It may be said that decompression is the most important fundamental principle of pre-operative preparation. It does not matter one iota whether the growth is situated in the right or left side of the colon. By the simple decompression operation of cæcostomy obstruction of the bowel is relieved, the permeability of the colon is reduced and lavage of the gut can be instituted so that a large quantity of septic and highly putrefactive material can be eliminated. When the bowel is cleansed saline administered daily via the cæcostomy opening will ensure a good water balance and prevent dehydration which is so likely to follow and is a serious menace when the major operation takes place.

Another pre-operative measure which has been found useful is the employment of polyvalent intestinal bacteriophages in the shape of enterofagos one ampoule being taken twice daily for at least a week before resection of the growth is undertaken. This is a better method



FIG 722.—MICROSCOPICAL DRAWING OF CARCINOMA OF THE SIGMOID COLON

than giving a vaccine of streptococci and colon bacilli intraperitoneally two days before operation. Early diagnosis is another important factor in the reduction of the mortality of cases of carcinoma of the colon. Perhaps the best method of attaining early diagnosis is by X-ray examination by modern methods. During the last ten years great strides have been made by radiologists both at home and abroad and the assistance that can now be given to the surgeon who is dealing with cases of colon cancer is immense.

Figure 724 is an excellent skiagram showing an annular carcinoma of the transverse colon. Fig. 725 is a skiagram taken after a barium enema in a man aged fifty-eight who had suffered from loose motions for some three months. Rectal examination was negative. The skiagram shows a definite carcinomatous stricture at the recto-sigmoid junction. A permanent colostomy was performed in the upper end of the sigmoid colon and was followed ten days later by an abdomino-perineal excision. The patient was alive and well four years later.

There can be no doubt that modern technique in radiology has been responsible for the early diagnosis of cancer of the colon. In any case of doubt it is the practitioner's duty to have the patient X-rayed.

Carcinoma of the cæcum usually starts in its lateral wall immediately opposite the ileo-cæcal valve and the growth is frequently large and fungating (Fig. 726). The onset of the condition is usually insidious and the duration of the symptoms



FIG. 723—CARCINOMA OF THE TRANSVERSE COLON (KING'S COLLEGE HOSPITAL MUSEUM)

prior to diagnosis is usually about eighteen months. In a critical review of twenty-five cases which were published in 1937 in the *British Journal of Surgery* it was found that the cases present themselves complaining of one or other of the following symptoms or some combination of them:

- (1) Mild dyspepsia, pain in the right flank, constipation, borborygmi (often diagnosed as chronic appendicitis)
- (2) A mass in the right iliac fossa
- (3) Anæmia and debility

Blood may appear in the stools and there may be attacks of diarrhoea. On further investigation some degree of anæmia and leucocytosis is usually found. A tumour is frequently palpable. A barium enema often clinches the diagnosis as a definite filling defect is seen in the region of the cæcum.

Cases of carcinoma of the cæcum are therefore commonly seen before any obstruction has occurred and the patient can be well

prepared for the operation which consists in excision of the cæcum ascending colon hepatic flexure and part of the transverse colon as well as the terminal 6 inches of the ileum (Fig 727). The best incision is a free muscle cutting oblique incision in the right iliac fossa. The incision is retracted well inwards and packs are inserted to keep the



FIG 724—SKIAGRAM TAKEN AFTER A BARIUM ENEMA SHOWING CARCINOMA OF THE TRANSVERSE COLON DIVERTICULOSIS AND DIVERTICULITIS IN THE SAME PATIENT (MR H C EDWARDS'S CASE)

small intestine out of the field only the bowel to be removed to be kept in view. Clamps are applied to the ileum and it is divided. The operator working from below upwards and from the outer side of the colon where he incised the peritoneum proceeds to mobilize the ascending colon with its blood and lymph supply. Care is taken

to avoid injury to the ureter and spermatic vessels. The hepatic flexure is freed by blunt dissection and snips with scissors, but care must be taken not to damage the retro-peritoneal portion of the duodenum. The transverse colon is now divided between clamps, and the portion of the omentum on the proximal part ligatured ready for removal. The blood vessels to the cæcum and colon can now be clamped and the bowel cut away portion by portion. The divided ends of the bowel are next invaginated by a series of purse-string

sutures and the end of the ileum drawn alongside the transverse colon. A side-to-side anastomosis is then made between them, the sutures being inserted as in a gastro-enterostomy. The suture line is reinforced with the omentum (Fig 728). The final stage is to reperitonize the raw area left by the incision made on the outer aspect of the colon and the section through its vessels. This is done *secundum artem*. The abdomen is closed with drainage, which should never be omitted because of the exudate from the raw area on the posterior abdominal wall. The tube may be brought out through a separate stab wound.



FIG 723—SALAGRAM OF RECTO SIGMOID JUNCTION AFTER BARIUM ENEMA

Oblique view showing carcinomatous structure. It is very important to take an oblique view in these cases as an ordinary antero-posterior view frequently does not reveal the structure.

The same operation is employed for growths of the ascending colon and hepatic flexure.

Carcinoma of the transverse colon usually takes the form of a small, hard, annular growth, and quite a percentage of cases are first seen when acute obstruction is present. The procedure in these cases is to do a preliminary cæcostomy, to allow the bowel to drain for ten days or a fortnight, and then do a resection of the growth, together with any glands in the transverse mesocolon, a lateral or end to-end union can then be performed. In the majority of cases metastases are late, and therefore the late results are excellent in these cases.

The cæcostomy opening is allowed to close soon after the resection operation is completed



FIG 726—CARCINOMA OF THE CÆCUM (KING'S COLLEGE HOSPITAL MUSEUM)

In cases of carcinoma of the splenic flexure and descending colon the plan of operation is quite simple. A preliminary cæcostomy is performed which is followed after a week or ten days by a resection of the growth and an anastomosis is performed between the transverse and sigmoid colons.

The sigmoid colon is the commonest site for cancer to occur in the colon. The operation mortality should be the same as for carcinoma of the transverse colon but this is not the case. Unfortunately quite a fair proportion of such cases come under surgical supervision when acute obstruction is present or even perforation of the bowel has taken place immediately above the growth or



FIG 727—THE EXTENT OF RESECTION OF THE GUT REQUIRED IN CARCINOMA OF CÆCUM

Perforation may either take place in the cæcum which is generally

greatly distended (Fig 729) It is these cases of perforation with peritonitis which are so difficult to deal with and they are the cases which put up the mortality rate When perforation has taken place the patients are often in *extremis* and dehydrated The surgeon can only do a *colostomy in the region of the perforation* and drain the abdomen In those cases which survive this simple operation (and they are few in number) the outlook is quite bright A *cæcostomy* is performed and this is followed later by resection of the growth

In those cases of carcinoma of the sigmoid colon where some kind of obstruction is present (and these form the great majority of the

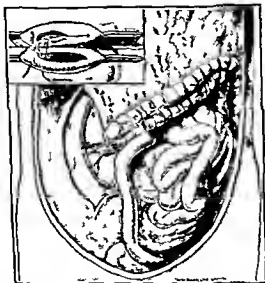


FIG 728—SHOWING THE COMPLETED OPERATION FOR EXCISION IN CASES OF CARCINOMA OF THE CÆCUM

The inset shows how the lateral anastomosis is performed

cases) a two-stage operation is advised At the first operation performed through a left lower paramedian incision the abdomen is explored and a *cæcostomy* completed At the second operation which is performed through an oblique muscle-cutting incision the growth is mobilized working from the outer side towards the mid line and a sufficiency of bowel is freed on either side to allow restoration of continuity (Fig 730) Four clamps are then applied to the colon the area is suitably packed off the bowel divided and the growth removed together with a wedge of mesentery The next stage is that of restoration of continuity Usually an end-to-end junction is made as this is possible without tension (Fig 731) the suture line being reinforced with omental tags The peritoneal covering on the

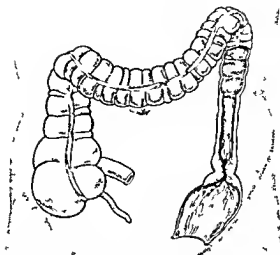


FIG 729 — DIAGRAM OF CONSTRICTING CARCINOMA OF THE SIGMOID COLON
 Dilatation of the cæcum hypertrophy of the descending colon and dilatation
 below the growth due to paralysis of the bowel

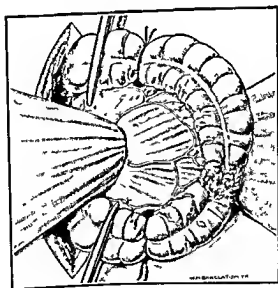


FIG 730 — DRAWING SHOWING HOW THE CLAMPS ARE APPLIED AFTER
 MOBILIZING A GROWTH IN THE SIGMOID COLON

postero lateral abdominal wall is now restored as completely as is possible. The abdomen is closed in layers with drainage. An alternative method, which has much to commend it, is the opera-

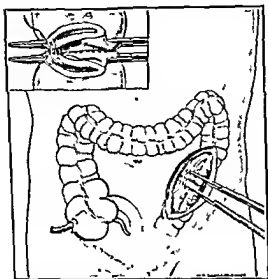


FIG. 731.—DIAGRAM SHOWING THE COMPLETION OF THE OPERATION FOR RESECTION OF THE SIGMOID COLON WITH END-TO-END UNION.

A cecostomy has been performed some days previously. The inset demonstrates the method of suture.

tion associated with the name of Paul and Mikulicz. This type of operation can be performed in the presence of moderate degrees of obstruction. A free incision is made over the tumour, which is then

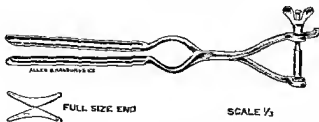


FIG. 737.—A USEFUL ENTEROTOME (DEVINE'S)

mobilized. The bowel is divided between clamps and the growth removed. The ends of the divided bowel are lifted out of the wound and their adjacent sides united by suture, the clamps being left *in situ*.

The wound is now closed and dressings applied around the clamps. At the end of twenty four hours the upper clamp is removed and the bowel functions through this colostomy. By the third day the second clamp may be removed and repair of the fistula commenced. On the spur between the two loops of bowel an enterotome (Fig 732) is placed, and the pressure gradually increased. Sutures hastening the closure may be inserted at the bedside without any anæsthetic. In about four weeks time in a favourable case the fistula will be quite healed, and, under a local novocain injection the parietes can be incised and the bowel allowed to drop back into position.

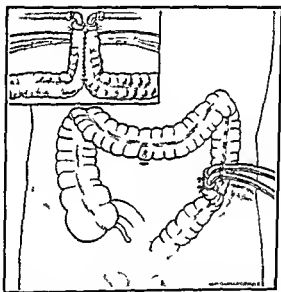


FIG 733—DIAGRAM SHOWING HOW TWO PAUL'S TUBES ARE FASTENED IN THE COLON AFTER RESECTION OF THE SIGMOID COLON

The smaller drawing illustrates how the two loops of the colon are joined prior to inserting the Paul's tubes

Devine of Melbourne has perfected a technique for partial colectomy which has given satisfactory results. The segments of bowel lying adjacent to each other which are to form the anastomosis are sutured together, clamps are applied and the growth removed. In removing the segment containing the growth the sero muscular layer is turned back as a cuff. The enterotome is applied and the ends of bowel so sutured that there is just room to remove the instrument. When the enterotome is removed the bowel shrinks and soon closes. A small plastic operation will close the defect in the anterior abdominal wall.

In other cases if there is considerable oedema of the bowel wall the loop of sigmoid containing the growth can be delivered and the growth excised. The two ends of the bowel are brought to the sur-

face and Paul's tubes tied in them (Fig 733). This is an operation which has saved many lives when the condition of the patient is very poor.

In the colon early diagnosis of cancer and early operation give excellent results. It is the late cases which are bad surgical risks and bring up the operation mortality figures.

Idiopathic Dilatation of the Colon (Hirschsprung's disease) is a rare affection met with in infancy but occasionally lasting on till young adult life. The cause in many cases is unknown but congenital contraction of the rectum has been found in some and recent work on the sympathetic nervous system suggests that the condition is due to sympathetic and parasympathetic imbalance. It is characterized by enormous distension of the colon especially of the sigmoid flexure possibly on opening the abdomen nothing but the colon is seen. The walls are hypertrophied and stercoral ulcers may be present. The abdomen is distended but soft and free from rigidity the child does not complain of pain and tenderness and vomiting is unusual. The most prominent symptom is constipation and that generally of a most obstinate character purgatives having no effect but to cause pain and vomiting. Enemata are often retained and even gas cannot easily be passed the introduction of a long flatus-tube is followed by the escape of very putrid gas in large quantities. Death results from cachexia perforative peritonitis or obstruction.

Treatment—Modern treatment consists in sympathectomy. This should be done at an early age before gross and irrecoverable changes have taken place in the wall of the gut (see Chapter XVIII).

Enteroptosis or Glenard's disease is a not uncommon condition in which there is a displacement downwards of the stomach and intestine but the liver, spleen and kidneys are often involved (general visceroptosis). The cause varies but sometimes it commences after an acute illness more usually it is chronic and develops gradually. The relaxed abdominal wall which follows repeated pregnancies is often present and tight lacing used to be an important causative factor. Women are much more frequently affected than men. The condition *per se* is not necessarily associated with symptoms but in a considerable number of cases marked neurasthenia is present possibly from the drag of the viscera upon the sympathetic plexuses in the posterior abdominal wall. The amount of displacement is no measure of the severity of the symptoms. The stomach may be well below the costal arch and when inflated stands out prominently both curvatures being visible it is usually distended atonically and succussion sounds may be heard. The relaxation of the small intestines is alluded to in connection with the aetiology of hernia (p 1276). The transverse colon may sag downwards into the pelvis and the kinking of the splenic and hepatic flexures thereby induced may be an important element in the production of constipation. It also drags on the duodenum and may give rise to symptoms erroneously attributed to gastric or duodenal ulceration. The spleen and liver may also slip downwards. Displacement of the kidneys is referred to under the heading Movable kidney (p 1369).

Treatment must be suitably modified according to circumstances and due allowance made for the neurasthenic element. A course of

Weir Mitchell treatment, i.e. rest and feeding is often valuable both for its influence on the nervous state and also in assisting to increase the deposit of fat. Electricity and massage to the abdominal walls together with appropriate remedial exercises help to restore their tone and to improve the condition of the underlying viscera. An abdominal belt or bandage will do much to relieve symptoms especially if applied with the patient in the Trendelenburg position. Operation is not to be lightly undertaken but if a fair test has been given to the above measures it may be justifiable to open the abdomen and stitch up into place organs like the stomach, transverse colon, liver or spleen or to brace up the abdominal wall by some plastic operation such as that suggested on p. 1302. For treatment of movable kidney see p. 1369. The question of removing or short circuiting the kinked colon may also have to be considered.

Intestinal Stasis is a term introduced to indicate a condition of abnormal delay of the bowel contents in some part of the intestinal canal especially the colon. This delay allows putrefactive changes to occur and in consequence toxins may be absorbed therefrom and produce not only a general depreciation of health but also considerable degenerative changes in many of the viscera and tissues. Sir Arbuthnot Lane has done excellent work in emphasizing the character and dangers of this condition although his theories and conclusions are not accepted by all surgeons. He attributes the whole range of phenomena to the assumption by man of the erect attitude and the natural consequential tendency of the intestines to drop. To counteract this a reactive formation of peritoneal bands and membranes occurs producing re-

sults more or less similar to those following peritonitis and attaching the intestines to parietal structures. Thus to the outer side of the ascending colon one often finds a set of membranous bands running downwards and inwards from the parietal peritoneum to lap over the intestine and be attached to the front of the ascending meso-colon; this thin vascular veil is sometimes termed *Jackson's membrane* (Fig. 734) and if at all exaggerated may cause interference with the activity of the colon. At the hepatic and splenic flexures similar developments occur and may cause such contraction as to kink the gut severely. Even more importance is attached by Lane to a band of adhesions running from under the surface of the mesentery to the anti-mesenteric border of the ileum a few inches from the cæcum; the contraction of this band causes a kink at the termination of the ileum (*Lane's ileal kink* Fig. 734) and thus determines retention of the ileal contents. The

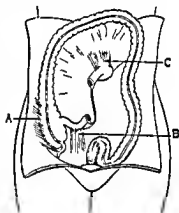


FIG. 734.—PERITONEAL BANDS OR THICKENINGS OFTEN ASSOCIATED WITH INTESTINAL STASIS.

A Jackson's membrane B Lane's ileal kink C kink at flexura duodeno-jejunalis

result of this is increased sagging of the small intestine in the pelvis and dragging on the duodeno-jejunal flexure, this is stated to cause a reactive formation of bands which first support the flexure, but, if excessive, subsequently kink it, causing dilatation of the stomach and duodenum (C). Similar bands and kinks may be developed elsewhere. The phenomena are looked on as mechanical and reactive, and not inflammatory, although structures, such as the appendix or gall-bladder, are often involved in the adhesions. This view is not universally accepted, many surgeons look on the bands as the result of inflammatory attacks and Sir Arthur Keith has shown that many of them are of congenital origin and due to an exaggeration of the antenatal plastic peritonitis which fixes the colon in its place.

The Symptoms arising from intestinal stasis are threefold (i) *Mechanical* results follow from distension of different portions of the intestinal canal, *e.g.* the stomach duodenum, ileum or colon. Most of these have been alluded to already, but one would especially emphasize the troubles that arise from prolapse of the colon into the pelvis. The colon becomes filled with liquid faecal material which cannot be evacuated. (ii) *Inflammatory* phenomena of many types follow this stasis *e.g.* gastric and duodenal ulceration, appendicitis colitis, etc. (iii) *Toxic* results necessarily ensue and include such conditions as enfeebled circulation, cold sweating, cyanosed extremities, facial pigmentation, muscular weakness with sundry nervous and perhaps mental perturbations. The resistance of the individual to bacterial invasion is also lowered and various infective diseases may supervene.

Treatment—Early and mild cases can often be treated effectively by improving the tone of the abdominal wall and increasing the motor power of the colon by a course of abdominal massage and suitable remedial exercises. Purgatives, intestinal antiseptics (such as liquid paraffin), careful attention to diet, and a sufficiency of rest in the recumbent posture will do good, a relaxed abdominal wall, of course, requires remedial exercises, a suitable external support, or operative treatment to tighten it up. It must be accepted as a cardinal dictum that mere looseness and displacement downwards of the colon is a matter of comparatively little importance in itself. Where, however, some definite cause of obstruction is present *e.g.* a band across the ascending or transverse colon, the caecum and part of the ascending colon may hang down into the pelvis and be literally transformed into a cesspool filled with putrid faecal material, the walls are often 'soggy,' thickened and inflamed. Under such circumstances caecoplication may suffice but more often complete removal of the caecum and ascending colon is advisable, and excellent results follow a hemicolectomy. The mortality is comparatively small (25 per cent). Under no circumstances should a complete colectomy be undertaken for intestinal stasis, the operation is a serious one, giving even in the most capable hands a mortality of 16.5 per cent, and the after results are sometimes most unfortunate, the patient suffering from constipation of an aggravated type or from incessant and intractable diarrhoea, owing to the removal of what is in reality the drying ground of the faeces.

Fæcal Fistula—This term is applied to any abnormal communication with the intestine through which passes a certain amount of the bowel contents (Fig 735). It differs from an artificial anus in that the greater portion or the whole of the fæcal matter passes through the latter in a fistula only a small portion is thus discharged.

Fistulæ may be of two types the *external* and the *internal* in the former the opening is in the skin in the latter the abnormal communication is with some viscus *eg* the bladder. The term *fistula dimucosa* indicates the existence of a communication with another section of the intestinal canal it may be of little importance if the affected segments are close together but should an opening be established between an upper and a lower segment *eg* between the upper end of the jejunum and the transverse colon nutrition will be seriously affected if the fistula is large enough to allow of the deflection of the greater part of the intestinal contents.

The condition may result from many causes but it is needless to discuss them *in extenso*. They may be divided into the following groups (1) Those due to conditions inside the bowel such as the

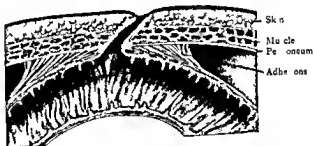


FIG 735—FÆCAL FISTULA

impaction of a foreign body this will lead to inflammation ulceration and localized peritonitis which will attach the affected coil of gut either to the abdominal wall or to some other viscus suppuration occurs constituting a localized intraperitoneal abscess which bursts either externally through the skin or internally into the attached bowel and possibly permits the foreign body to escape. If the cause thus disappears or is removed the fistula will often close spontaneously.

(2) Cases associated with primary disease of the intestinal wall are not uncommon and amongst them may be mentioned appendicitis diverticulitis tubercle or actinomycosis and malignant disease. Strangulated hernia sometimes results in the formation of a fæcal fistula in consequence of a localized gangrene of the bowel wall.

(3) Extra intestinal conditions may also lead to the establishment of a fæcal fistula as *eg* tuberculous peritonitis where an abscess forms outside the gut in the diseased peritoneal focus and opens both externally and internally this occurs most frequently in the neighbourhood of the umbilicus. Wounds of the abdominal wall such as stabs would be included in this category.

(4) Finally one must mention the congenital variety resulting from the persistence of a Meckel's diver

ticulum and this again is usually umbilical in position and (3) the post-operative where the fistula is made deliberately for drainage irrigation or feeding purposes (cæcostomy or jejunostomy)

All these conditions are referred to in the various sections dealing with the originative disease or condition and it is needless to discuss treatment of them apart from that of the cause to which they are due

Operations on the Intestines

1 Enterotomy is a term which is only correctly applied to an incision made into the intestine either for the removal of a foreign body such as a gall stone or for the examination of its interior. The wound should always be placed in the longitudinal axis of the gut and along its anti mesenteric border. It is closed by a single or double row of sutures.

2 Enterostomy, or the formation of an artificial opening into the bowel may be undertaken for several reasons and any part of the gut may be opened.

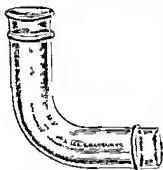


FIG 736 FALL'S TUBE
(GLASS)

(a) The jejunum may be brought to the surface and opened (*jejunostomy*) in cases of cancer of the stomach where gastro-enterostomy and pylorotomy are impossible and the patient is dying of inanition. He can subsequently be fed by the fistula in this way produced. The actual operative procedure is as for gastrostomy. It may also be employed with advantage in ulcers of the stomach which have contracted extensive adhesions posteriorly and especially to the pancreas when the condition of the patient does not warrant the performance

of a serious operation. After feeding by this means for six or eight weeks excision can sometimes be undertaken safely and it may be found that the ulcer is completely healed and that the adhesions to the pancreas are slight on account of the subsidence of the inflammatory phenomena. Some surgeons advise that the jejunum should be brought to the surface through a hole in the omentum so as to prevent any possibility of leakage. Jejunostomy is also sometimes used in the treatment of acute obstruction when the patient is too ill to permit of any exploratory procedure directed to the cause.

(b) The ileum may need to be opened (*ileostomy*) and drained in cases of obstruction not lower than the cæcum or ascending colon when the small gut is much distended and the patient's general condition so bad that no prolonged search for the cause and no attempt to deal directly with it even if obvious are possible. The abdomen is opened either in the middle line or in the right iliac region, a suitable distended coil is withdrawn and incised after carefully protecting the peritoneal cavity from faecal infection. A large trocar and cannula are introduced so as to allow the first gush of flatus and fluid contents to escape.

the opening is then enlarged and a rubber drainage tube stitched in or a Pauls (glass) tube tied in (Fig 736) by means of a purse-string suture passing in and out through the whole thickness of the bowel wall and the affected coil of intestine fixed to the abdominal wall. A thin tube of rubber is attached to the other end of the glass tube and through this the intestinal contents are temporarily allowed to escape without contamination of the peritoneal cavity or of the wound.

If the patient recovers from the acute symptoms a second operation will be needed in order to deal with the cause as well as to re-establish the continuity of the intestinal canal.

(c) Colostomy, or as it is often incorrectly termed colotomy is frequently employed in dealing with diseases of the lower bowel and is an extremely successful proceeding.

The character of the artificial opening varies considerably according to whether or not it is intended to be a permanent condition. If merely a temporary opening is required the smaller the portion of bowel secured to the parietes the better since the subsequent operation for its closure is so much simpler (Fig 737). But when a permanent aperture has to be

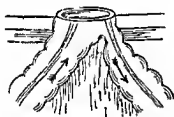


FIG 737 — DIAGRAM OF TEMPORARY COLOSTOMY SHOWING THE SINGLE OPENING ON A LEVEL WITH THE SKIN THE PASSAGE TO THE LOWER BOWEL BEING BLOCKED BY A SPUR OF MUCOUS MEMBRANE

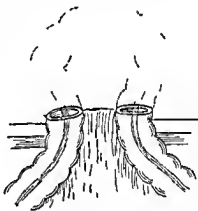


FIG 738 — DIAGRAM OF PERMANENT COLOSTOMY SHOWING THE TWO OPENINGS SEPARATED ONE FROM THE OTHER BY A SECTION OF THE MESENTERY

established the surgeon's aim should be to divert totally the course of the faeces and hence it is desirable to withdraw a portion of the gut from the abdominal cavity and to cut away a complete segment including also if possible a portion of the mesentery. By this means the upper and lower openings are brought to the surface of the skin and separated from one another (Fig 738).

Appendicostomy is performed in some cases of ulcerative colitis. Local anaesthesia is sufficient in most cases and the appendix is exposed as in the operation of appendicectomy. The peritoneum is sutured to the caecum around the base of the appendix (Fig 739). Care is taken to preserve the mesentery of the appendix. The wound is closed in the usual manner. After seventy-two hours the appendix is cut off down to the last inch which is then split longitudinally and the

flaps anchored back (see Fig 739) This can be performed with a diathermy cautery

Appendicostomy is preferred to cæcostomy or ileostomy because it is easily and quickly performed with a negligible mortality There is a minimal faecal leak and no odour It is in fact a very satisfactory method of irrigation of the large bowel

Cæcostomy is sometimes required in cases of membranous or ulcerative colitis where there is an abundant secretion of pus and the patient's life is threatened by pyrexia and toxic exhaustion and in those cases where the appendix has been removed The object of the operation is twofold (1) to prevent the irritation caused by the passage of the faeces over the ulcerated mucous membrane and to permit the colon to be irrigated Inasmuch as the contents of the bowel at this

level are fluid and irritating the opening must be as small as possible and this is effected by stitching firmly into the bowel a piece of rubber drainage tube as in gastrostomy and then fixing the bowel to the skin and abdominal muscles It is possible however that in spite of every precaution the skin will become inflamed

Cæcostomy is also required for acute obstruction of any portion of the colon above the pelvic segment in order to empty and drain the distended and paralyzed bowel It must of course be followed by excision of the growth with restoration of the continuity of the intestine or by some suitable short-circuiting operation and until the restored colon is functioning satisfactorily the caecal fistula must not be closed.

The fact that this opening is in the right iliac fossa permits the major operation to be undertaken without infection of the wound. Finally the caecal fistula is closed by a plastic operation

Transverse Colostomy is now seldom employed although at one time it was a favourite operation for acute obstruction of the distal bowel but as just mentioned cæcostomy is preferable In a few cases however it may still appear to be desirable and is undertaken in a manner somewhat akin to an iliac colostomy under similar circumstances

Iliac Colostomy consists in making an artificial opening temporary or permanent into the descending colon or sigmoid flexure. It is required under the following conditions (1) For congenital absence of the rectum when a perineal incision has failed to discover it (2) for

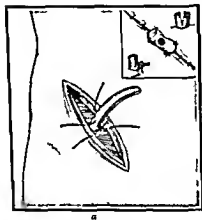


FIG 739

a The base of the cecum is sutured to the peritoneum b special method of dividing the appendix and suturing flaps

chronic obstruction of the lower end of the large intestine which cannot be relieved by enemata or medical means such as that arising from diverticulitis simple or malignant stricture or from the pressure of pelvic tumours (3) for carcinoma of the rectum or sigmoid flexure whether obstruction is present or not if a radical operation is impracticable or as a preliminary to excision (4) for some cases of syphilitic tuberculous and other forms of ulceration of the rectum which cannot heal as long as they are irritated by the passage of faeces (5) for irremediable cases of recto vesical and recto vaginal fistula whatever their origin (6) for volvulus of the sigmoid flexure the iliac operation being needed not only to relieve the obstruction but also to prevent recurrence and (7) for gunshot or other wounds involving the rectum with extravasation of faeces

Operation—Various incisions are used some surgeons employ a vertical incision through the outer fibres of the rectus muscle in the hope of gaining some measure of sphincteric control Others utilize an incision 2 or 3 inches in length made at right angles to a line extending from the anterior superior spine to the umbilicus the centre of the incision corresponding to the junction of the outer and middle thirds The abdominal parietes are divided either in the line of the cutaneous incision or by splitting the muscles in the line of the fibres the latter is only desirable when there is but little distension and when it is not necessary to make an extensive exploration of the viscera

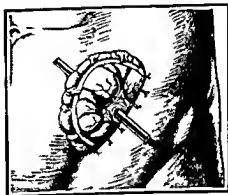


FIG 740—ILIAC COLOSTOMY

A glass rod supports the colon on the abdominal wall

The sigmoid flexure is sought for and gently drawn out and the upper part is selected for fixation in the wound so as to diminish the risk of subsequent prolapse Many different plans of fixation are in vogue (1) Undoubtedly the best if possible is to make an opening through the meso-colon and through this to draw together the segments of the abdominal wall by suitable deep stitches and superficial sutures in the skin The possibility of undertaking this operation depends on the degree of laxity of the sigmoid flexure where the meso-colon is short the peritoneum to its outer side should be freely divided and the colon mobilized inwards to a sufficient extent to enable this type of operation to be undertaken (2) If in spite of its mobilization it is not very free it is better to make a hole through it and to introduce a glass rod which resting on the abdominal wall on either side supports the gut until suitable adhesions have formed (Fig 740) A closely fitting rubber tube should be drawn over each end of the rod so as to

prevent the risk of it slipping aside. It is also well to steady the bowel in position by a suture at each end passing through the skin on either side and also through one of the longitudinal muscular bands. The operation is completed by ligaturing and cutting away all available appendices epiploicæ (iii). A useful method of fixation is to pass a mattress suture of strong silk through the parietes (including the skin, muscle and peritoneum) on either side the stitch traversing the meso-colon *en route*. By tying the ends together the parietes are brought into close apposition with the meso-colon. The ends of the parietal wound itself should be closed as much as possible so as to prevent subsequent prolapse.

If the bowel does not need to be opened at once it is covered with purified protective and a dressing is applied. After twenty-four hours or more the gut may be safely opened as adhesions will have shut off the peritoneal cavity and a glass or rubber tube is stitched or tied in. No anæsthetic is required for this. At the end of three or four days these tubes become loose and after about a week it is desirable to trim up the bowel removing any unnecessary redundancy.

When cicatrization of the wound is complete a protective apparatus is required in order to keep the patient clean. This should consist of a hollow oval cup of vulcanite or celluloid with a rolled edge and kept in position by an abdominal belt. This hollow cup should be large enough to include a 2 inch margin of skin all round the opening and in the concavity a small portion of antiseptic dressing is placed. Such an apparatus enables the patient to go about in comparative comfort the bowels are encouraged to act thoroughly every morning by means of a glycerine enema so that no further disturbance need occur during the day.

It is sometimes desirable to close a colostomy wound after a shorter or longer interval. The plan usually adopted at the present day is to dissect up the margins of the wound freeing the gut from its attachments to surrounding parts and excising the affected segment in this way an end-to-end anastomosis can be secured without leaving parietal adhesions.

3. Enterectomy or excision of a portion of the bowel is required in the following conditions (a) For the removal of gangrenous gut after strangulation whether internal or external (b) in the treatment of multiple penetrating wounds as after a stab or gunshot injury (c) for the closure of an artificial anus or fæcal fistula (d) for the removal of a simple or malignant stricture and (e) in some cases of intussusception. Naturally the results vary largely with the condition for which it is performed with the site of the lesion and with the experience and skill of the operator. A much higher rate of mortality follows when the excision is done for malignant disease or for gangrene following strangulation or for intussusception than when performed for other causes. Operations on the large intestine are also less favourable than those directed to the small gut. Whenever practicable the bowel should be thoroughly emptied prior to operation and rendered as sterile as possible by the use of such drugs as calomel (gr i daily) salol β naphthol kerol etc. for a few days previously.

Should this be impossible and when the bowel is distended it must always be opened previously and drained and the anastomosis delayed until the bowel is empty.

The abdomen is opened by any suitable incision and the portion to be removed clearly defined the general peritoneal cavity being protected by a careful packing with abdominal cloths or gauze. The bowel must then be *clamped* on either side of the seat of operation so as to prevent the escape of intestinal secretions or feces.

The affected portion is removed by scissors or diathermic cautery and a V shaped portion of the mesentery after securing as far back as possible the main nutrient vessels to the diseased area. It must be remembered that the terminal vessels run circularly round the gut and have but few lateral anastomoses and therefore it is desirable that the incisions should diverge slightly from the mesenteric attachment otherwise the projecting edge of the anti mesenteric border is certain to slough and septic peritonitis will result. The wound in the mesentery is subsequently secured by sutures and the divided ends of the bowel united by either an end to end or a lateral anastomosis.

4 End-to-end Anastomosis is effected by *simple suturing* without any special apparatus the surgeon trusting to the deftness of his fingers and the accuracy of his stitches.

The mesenteric and anti mesenteric borders are first united by stitches which are left long for the assistant to hold the gut is thereby steadied (Fig 741). Two rows of sutures are used the first passes through the whole thickness of the bowel walls but as close to the divided edges as possible so as not to invert too large a portion and thus diminish the lumen. The second is a sero muscular stitch of the Lembert or Cushing type. Catgut is the suture material employed. Extreme care must be taken in dealing with the mesenteric attachment as the peritoneal coats separate there in order to enclose the bowel and the muscular coat retracts considerably leakage is more likely to occur at this point than at any other.

5 Lateral Anastomosis of the intestine is often employed in order to undertake the short circuiting of some malignant growth or of a stricture which cannot otherwise be dealt with. It is also used instead

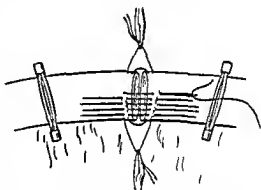


FIG 741—END TO END ANASTOMOSIS BY SIMPLE SUTURING

For clearness sake the first row of stitches in the mucous membrane has been omitted and the sero muscular sutures of the Lembert type are represented as interrupted. In practice one would use a continuous stitch.

of end to-end anastomosis to unite divided segments of intestine. The open ends are first entirely closed after division by knife or thermo-cautery. The portions of bowel are now made to overlap and the actual anastomosis is performed as for gastro-enterostomy (Fig 742). Suitable clamps are applied above and below, and the coils are brought into close apposition. Longitudinal incisions are made through the

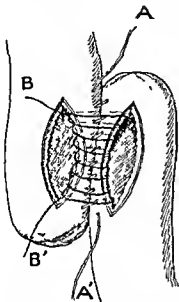


FIG 742 — LATERAL ANASTOMOSIS OF BOWEL AFTER COMPLETE DIVISION

The divided ends are closed by sutures and approximated by a sero-muscular continuous stitch (A A') the incisions in the bowel are then made and the mucous membranes united by a continuous stitch (B B') and finally the sero-muscular suture is carried round the whole opening. Only the deep layer of sutures is shown here and they have not been drawn tight so as to indicate their relative positions.

sero-muscular coats, and these are united on the posterior aspect of the proposed junction. The segments of bowel are then opened and any fluid or solid contents carefully mopped up and removed. A continuous suture through the whole thickness of the wall is carried round the opening back and front, and serves not only to unite the segments together, but also as a means of hæmostasis. A sero-muscular row of stitches completes the anastomosis. Finally, the divided edges of the overlapping segments of the mesentery are sutured so as not to leave an aperture through which internal strangulation might occur.

6 **Lateral or End-to-side Implantation** is a procedure not uncommonly required in order to connect the divided end of the ileum to the transverse colon. The junction may be made by simple suturing two rows of stitches being introduced.

7 **Colectomy**, or excision of a large or small portion of the large intestine is not quite so simple a matter as removal of a part of the small bowel, owing to the greater complexity of the peritoneal reflections and its less mobility. The latter difficulty can however be largely overcome, and the colon freely 'mobilized' by dividing the peritoneal attachments on the outer sides of both ascending and descending colon, or by detaching the transverse

colon from the under side of the omentum. The varying portions of the bowel can then be freely drawn over to the middle line with the vessels nerves etc. being held merely by one layer of peritoneum. By the assistance of this procedure, large portions of the colon can be removed without much danger or difficulty, and union of the upper and lower segments can be readily effected, either by end to-end or

by lateral anastomosis after closing the divided ends. One essential precaution must be observed if success is to be obtained *viz* the colon must be satisfactorily emptied beforehand in any case of partial or complete obstruction with retention of the faecal contents a preliminary caecostomy should be undertaken.

8 Caecoplication is occasionally required in the treatment of a dilated atonic caecum which is often displaced downwards into the pelvis. It consists in infolding the wall by suturing together two of the longitudinal muscular bands thus reducing the lumen by one third. This suturing extends from the caput caeci as far as or a little beyond the ileo caecal valve. It is not a desirable procedure when subacute inflammatory changes are present in the caecum and ascending colon but apart from these it is sometimes useful.

Appendicitis (Syn Perityphlitis Epityphlitis etc)

Appendicitis is an affection which may appear at any time of life but it is most common in young adults and the male sex is more frequently attacked than the female. The disease is sometimes of but slight significance but occasionally runs such a virulent course as to destroy life in a few hours. Its importance lies in the fact that it is an infective process and inasmuch as the peritoneal envelope is generally involved a certain degree of peritonitis is almost necessarily a consequence.

Ætiology—Many different conditions contribute either directly or indirectly in determining an attack of appendicitis. (1) The appendix is usually looked on not as an actively functional structure but as a degenerated relic of little importance. It often has but a poor blood supply derived from the posterior ileo caecal branch of the ileo-colic artery. The main nutrient vessels run along the free border of the meso appendix but a second twig often runs down the base of the mesentery. (2) A large amount of lymphoid tissue is present in the mucous membrane especially in young people so that the title of abdominal tonsil has been applied to it. The lymphoid follicles have a tendency to atrophy with advancing age. Bacteria are constantly found within the lumen and in the lymphoid follicles and inflammatory processes are set up by them within its walls. Is it possible that herein lies the secret of the appendix *viz* that it plays some part in producing immunity from these germs and that indiscriminate removal of healthy appendices is an interference with one of Nature's immunizing mechanisms as injudicious and often as harmful as is unnecessary removal of tonsils and adenoids? Acute appendicitis is then to be looked on as a losing fight put up by the appendix on behalf of the body generally the germs prove too powerful for the local immunity. Chronic appendicitis would then represent a maintained fight against a persistent enemy and A obliterations a condition resulting from a successful campaign at the expense of the defensive mechanism. This may also explain why removal of a chronically inflamed appendix is often followed by so little benefit to the patient. (3) Its length and direction vary considerably in

different individuals. In length it may measure anything between 11 and 12 inches but is usually 3 to 4 inches long obviously added length means increased liability to harmful kinks and twists. As to direction it may lie in any axis and the clinical picture is largely influenced by its anatomical position. The commonest situation is behind the cæcum and ascending colon directed upwards but it is not unusual for it to overhang the pelvic brim and then pelvic complications almost always accompany an attack of appendicitis. When the appendix lies to the outer side of the cæcum the inflammatory reaction may be more localized. (4) The extent of attachment of the meso-appendix is an important element since the portion which projects beyond its free border is less well supplied with blood. As a matter of fact the mesentery often does not extend beyond the junction of the middle with the distal third and perforation not unfrequently occurs about this spot. (5) The communication with the cæcum is usually small and is guarded by an insignificant fold of mucous membrane known as the valve of Gerlach. Sometimes this aperture becomes blocked or the orifice stenosed as the result of a preceding inflammation of the mucous lining of the cæcum so that an accumulation of mucus occurs within the appendix leading to its dilatation into a cyst like pouch. (6) The content of the normal appendix consists of a little mucus and a certain number of bacteria similar to those found in the neighbouring intestine a generalized infection of the intestinal canal perhaps the result of oral sepsis will obviously add to this number. *Foreign bodies* such as pins etc. are occasionally found within it and by their presence and irritation may light up an attack of appendicitis. They are much less common than was formerly imagined and the fact that the opening into the intestine is generally not larger than to admit a No. 8 catheter will explain this rarity. *Fæcal concretions* are comparatively common they are oval bodies varying from 1 to 1 inch in length and usually laminated consisting of dried fæcal material mixed with myriads of bacteria and perhaps with a pip or foreign body as a nucleus. They are not very hard and can easily be cut with a knife or even crushed between the fingers. Occasionally they can be recognized in a radiograph of the pelvis taken for other reasons. (7) Appendicitis is not unfrequently associated with a true typhilitis or with a more generalized colitis probably due to chronic constipation. Dysenteric ulceration may involve the appendix or lead to stenosis of its orifice but it is rarely implicated in typhoid fever. (8) *Injury* in the shape of a strain or sudden twist is not unfrequently mentioned as the cause of an outbreak and probably acts by displacing a long appendix in such a way as to lead to kinking and possibly to obstruction of the nutrient vessels. When a concretion is present the final attack may be determined by some *traumatism* which modifies the vascular conditions around it.

There can be no question as to the greatly increased frequency of appendicitis at the present day especially amongst those who live in large towns or cities. It is difficult to assign any one cause for this but possibly many conditions may be at work e.g. (a) Dental disease

and degeneration, and consequent oral and intestinal sepsis (b) The bolting and non mastication of meals associated with the hurry and scurry of modern life leading to chronic irritation of stomach and bowel (c) Chronic constipation is a most important factor (d) The greatest dietetic change of recent years consists in the increased amount of meat that is eaten

Pathological Anatomy—Appendicitis is an infective malady, due to invasion of the walls of the appendix by organisms especially the *Streptococcus pyogenes* the *B coli* and other anaerobic intestinal bacteria These find an entrance into the wall of the appendix either through an eroded area of the mucous membrane due to the



FIG 743—APPENDIX WITH STRICTURE AT PROXIMAL END

The patient was a boy aged seven years who had had several attacks of pain in the abdomen with high temperature lasting a few hours sickness and tenderness in the right iliac fossa evidently due to retention of secretion

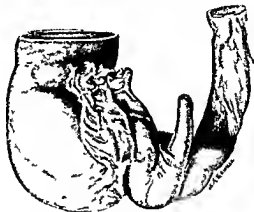


FIG 744—VERMIFORM APPENDIX TIED DOWN BOTH TO CÆCUM AND ILEUM AND DOUBLED ON ITSELF BY OLD STANDING ADHESIONS

The appearances in this illustration are very characteristic of what is frequently seen but the case from which it was taken was a very unusual one. It occurred in a baby of seven days who was operated on for acute obstruction due to the adhesions which were old standing and evidently ante natal. The child died and the cæcum was subsequently removed

impaction of a foreign body or of a faecal concretion or else they are absorbed into the lymphoid tissue so abundantly present and are able to overwhelm the protective mechanism provided thereby. The results may be best described under the following headings

(1) **Changes in the Appendix itself**—In the simpler forms a mere catarrh of the appendix results. The organ looks red and swollen, and its peritoneal surface may be smooth or roughened by loss of endothelium and deposit of lymph. It feels stiff from effusion and has lost its natural flexibility. The muscular coats are often infiltrated with leucocytes and this is especially noticed around the hiatus muscularis through which the vessels enter. The mucous membrane

is thickened engorged and infiltrated with polymorphonuclear leucocytes and here and there erosion or ulceration is present. If the process goes no further healing occurs after a time and this is often associated with *fibrosis* which may show itself (a) as a more or less generalized sclerosis of the whole appendix which may remain stiff and hard and is perhaps doubled on itself (Fig 744) or (b) as a stricture of the tube (Fig 743) which leads to retention of a mucous or mucopurulent effusion (hydrops or empyema of the appendix) or (c) obliteration of the appendix may occur (*appendicitis obliterans*). This usually commences at the tip and works up towards the gut but is not completed until the patient has suffered from many mild attacks. (d) Occasionally small *diverticula* or pouches (Fig 745) form as the result of a hernial protrusion of the mucous membrane through some

gap in the muscular wall e.g. the hiatus muscularis. They are usually not larger than a hemp-seed but are of importance since the thin walls readily give way and thereby a perforative peritonitis may be lighted up.

When *ulceration* occurs the appendix is likely to be more seriously invaded with micro-organisms and *suppuration* of many types may ensue. It may contain muco-pus in its lumen and this may increase to the point of determining rupture of the appendix within a few hours or the whole substance of the tube may be yellow with a diffuse purulent infiltration. The ulceration may gradually spread through the walls and lay open the peritoneal cavity giving rise to a local or diffuse suppurative peritonitis.



FIG 45 DIVERTICULA OF APPENDIX
(KING'S COLLEGE HOSPITAL MUSEUM)

One has perforated the others are intact

Necrosis or *sloughing* of the appendix is due to an acute interstitial inflammation spreading from an impacted concretion or from an ulcer of the mucosa or results from kinking and thrombosis of the appendicular vessels in the meso-appendix. The whole appendix may slough or merely a portion and then usually the tip or the part immediately opposite the distal end of the meso-appendix. The necrotic tissue is soft and easily torn of a blackish brown or green colour and always extremely offensive. It may be associated with a *perforation* through which the concretion may escape. In all these cases a grave peritoneal infection follows.

(2) *Changes in the Cæcum* may accompany appendicitis. In the *catarrhal* variety a generalized typho-colitis is often present and perhaps it would be more correct to speak of appendicitis as a com-

plication of that condition. In these cases most careful discrimination is needed in order to prevent needless operation which will not improve the patient's health. In *suppurative* appendicitis the cæcum is generally inflamed and infiltrated, but rather from the peritoneal aspect than from within, operative treatment will then be quickly followed by resolution. Rarely does the inflammation become so severe as to lead to suppuration or necrosis of the wall of the cæcum. Should this occur, it usually involves the base of the appendix and may be followed by a fæcal fistula.

(3) The **Peritoneal Phenomena** associated with appendicitis are of the utmost importance.

In the milder cases the peritonitis is *protective* in type. The serous coat of the appendix becomes inflamed, sheds its endothelium, and becomes roughened by a deposit of lymph, and this results either in a thickening of the wall, or in a formation of *adhesions* which tie down the appendix in various directions. Most commonly it is simply fixed to the cæcum along part of its length, but sometimes it is firmly united to it for its whole extent. Adhesions may develop between the appendix and the omentum, the mesentery, or ovary, etc., in fact, it may be united to almost any of the viscera, and may thereby give rise to some form of acute obstruction. It may also contract adhesions to the fascia over the psoas sheath or iliac vessels.

In the more serious cases an *infective* peritonitis occurs, and a *localized intraperitoneal abscess* is by no means uncommon, its extension is limited by the formation of adhesions between the omentum, the parietes and neighbouring coils of intestine. Its exact anatomical relations depend on the original situation of the appendix. Frequently it is located below and behind the cæcum, sometimes it burrows down into the pelvis, in other cases it passes inwards amongst the intestines, or it may track up towards the liver either on the inner or outer side of the ascending colon.

Sometimes, when the general health is good and the infection not too virulent, the abscess may remain quite limited, and the pus be completely absorbed, or it may be encapsuled and inspissated. More frequently it increases in size, and may burst externally, its approach to the surface being heralded by brawny swelling, redness, and œdema, the most usual sites for external pointing are the outer part of the iliac fossa and the lumbar region. It may also open into any of the viscera, and then most commonly into the cæcum or bladder. Finally, it may break through the peritoneal adhesions, and involve the general serous cavity, causing acute diffuse peritonitis, in other cases a serous effusion into the peritoneal cavity is found, resulting from the irritation of the abscess, and disappearing when it is opened. The pus contained in the abscess is usually of a stinking character, and in cases of sloughing of the appendix the fœtor may be intense, but the amount of smell is no gauge of the virulence of the process. Sometimes the debris of a broken down concretion can be recognized in the pus, and sometimes a portion of the appendix as a slough. Gas is also present in some cases, having escaped from the bowel or been generated by the activity

of gas producing organisms of which the *B. perfringens* (H. Welch) is the most important.

In the worst cases a *spreading septic peritonitis* is observed with but little tendency to limitation. The line of diffusion is governed by the anatomical relations of the appendix. If it is situated above the brim of the pelvis and on the outer aspect of the meso-colon the effusion may extend to the right kidney pouch and a subphrenic abscess be determined. If it is on the mesial aspect of the meso-colon the effusion will probably be limited by the mesentery to the lower half of the abdomen and will occupy the pelvis and left iliac fossa. In time however the whole peritoneal cavity will be affected and then operative treatment is little likely to be successful. The effusion in the first place is serous and due to streptococci but later it becomes turbid and finally fibrino-purulent or frankly purulent.

(4) Various complications may be associated with any of these different types of appendicitis. (a) The veins in the meso-appendix may become thrombosed and infected with pyogenic organisms. detachment of emboli may lead to the occurrence of *pyelephlebitis* and pyæmia. (b) *Thrombosis* of the femoral vein may develop if on the right side it is probably due to implication of the right iliac vein in the inflammatory process but if it happens as is much more common on the left side it must be due to general toxic causes or if it occurs after operations to thrombosis spreading from vessels divided in the anterior abdominal wall. (c) Chronic or subacute ovaritis often accompanies appendicitis in women it is probably due to the position of the appendix which hangs over into the pelvis. (d) Various renal complications may supervene usually from pressure of the inflammatory mass on the renal vein or on the ureter as it crosses the pelvic brim resulting either in hæmaturia or in renal colic. (e) Inflammation of an appendix located in a femoral sac is referred to hereafter. (f) Lastly obstructive phenomena may be induced by the paralyzed condition of the inflamed intestinal wall or true obstruction may develop later from linking or strangulation of a coil of intestine by bands or adhesions.

Clinical History—(1) The mild variety of the disease known as a simple *catarrhal appendicitis* to which is added merely a localized plastic peritonitis usually commences somewhat suddenly though the attack may be preceded by malaise and abdominal discomfort. The patient is seized with pain at first referred to the umbilicus or to any part of the abdomen but at the end of twenty-four to forty-eight hours it localizes itself in the right iliac fossa. It is often of a sharp cutting character but varies much in intensity and duration. Fever is usually present and the patient complains of nausea and vomiting but the latter symptom does not last long. Constipation results but in children it is sometimes replaced by diarrhoea and that even blood stained so that the condition may even be mistaken for typhoid fever.

On examination the abdominal wall is found to be more rigid than usual especially over the right iliac fossa and the right leg is often drawn up to relax the muscles. Definite tenderness is noted on

pressure, and the patient will often, but by no means constantly, refer it to a spot about $1\frac{1}{2}$ inches from the anterior superior iliac spine along a line drawn to the umbilicus (McBurney's spot, Fig 526) Sudden lifting of the hand after deep pressure often elicits sharp pain in appendicitis or other inflammatory lesions In many cases when the appendix is directed backwards there is marked tenderness in the lumbar region, but if it points downwards into the pelvis, the pain and tenderness may not be evident except on rectal or vaginal examination which should never be neglected A definite swelling may sometimes be detected by palpation, usually above the outer half of Poupart's ligament, but varying in its position with the site of the appendix, it may be dull on percussion, but is frequently tympanitic, since it consists of coils of intestine and omentum matted together around the appendix

Cutaneous *hyperæsthesia* is manifested in more than half the cases of appendicitis It is demonstrated either by stroking with a pin point held at right angles to the surface, or by light pinching In the former the two sides of the abdomen must be tested, as also the regions above and below the appendix area, which is usually contained within the triangle marked out by the middle line, Poupart's ligament, and a line drawn horizontally outwards from the umbilicus In the pinch test corresponding portions of skin are gently pinched between the thumb and finger on both sides of the abdomen, and the patient estimates the difference in sensation The area of hyperæsthesia varies with different viscera, but it is uncommon to find it present in the absence of peritoneal inflammation The appendix area corresponds in the main with the distribution of the tenth dorsal segment Hyperæsthesia is better marked in young adolescents than in older patients, and may be exaggerated in hysterical or neurotic people As the inflammation subsides, the area of hyperæsthesia gradually diminishes, its total disappearance without improvement of the general condition usually signifies grave mischief in the appendix, such as gangrene

An important aid to diagnosis in many mild cases, especially in the presence of adhesions, is the causation of pain in the region of the appendix by pressure over the *left* side of the abdomen directed towards the middle line In not a few cases tenderness is also noted along the inner border of the ascending colon and upwards towards the navel, this is probably due to swelling of the mesenteric glands, which on operation are often found enlarged and congested

This simple form of disease usually lasts three or four days, and then, if properly treated resolves satisfactorily without abscess formation It is exceedingly common, and the prognosis is, on the whole, favourable

(11) The more serious variety, resulting in a localized abscess, may commence in a similar way, but with more acute symptoms There may be an initial rigor, and the temperature soon runs up, even to 104°F General abdominal tenderness and distension follow, constipation is often absolute, and fecal vomiting may occur The muscles on the right side of the abdomen are held tense and rigid, and a well-marked fulness can sometimes be seen as well as felt in the iliac fossa,

it is not necessarily limited to the right side but may be found in the middle line of the abdomen or elsewhere. Under a careful regime this may disappear and the symptoms gradually abate in their severity the temperature and the pulse falling concurrently but it is very common for suppuration to ensue and this is indicated by the temperature persisting at its original high level or by the pulse-rate increasing in rapidity. The abscess develops round the appendix and is primarily intraperitoneal. Occasionally it bursts into the bowel and thereby relief is gained without the assistance of surgery. Some authorities indeed maintain that this occurs in every case of the more severe type which resolves. In other instances it may point externally, either through the anterior abdominal wall which becomes congested and oedematous as the pus approaches the surface or through the loin. Not unfrequently it tracks up along the inner or outer side of the ascending colon and then may get into relation with the under surface of the liver. In other patients and especially when the tip of the appendix lies over the brim of the pelvis the pus travels downwards and forms a collection in front of the rectum; the surgeon must never omit a rectal examination in appendicitis where the temperature is of such a nature as to suggest the existence of an abscess and yet no evidence of one can be found. Should it burst into the peritoneal cavity all the phenomena of acute perforative peritonitis with grave toxæmia supervene probably indicated by severe pain sudden fall of temperature rapid collapse and failure of the circulation leading rapidly to a fatal issue preceded by increasing abdominal distension.

In not a few cases the patient's general symptoms improve after the first outbreak the temperature may become normal the pain decrease and the vomiting cease. It is often difficult to be certain whether this improvement is merely temporary or is the commencement of a true convalescence. Under the former circumstances i.e. if it is merely an *interval of quiescence* careful examination will probably reveal some disturbing factor either the abdominal distension persists or perhaps hiccough is present or well marked tenderness continues perhaps only to be detected *per rectum* or the pulse-rate may remain unduly high. After a few days the temperature begins to rise once more the focal symptoms become more urgent and a localized abscess forms.

A blood-count will often assist in making a diagnosis as to the presence of pus. Readers are referred back for a full consideration of *leucocytosis* it will suffice here to state that a leucocyte count under 20 000 is merely indicative of an inflammatory attack well resisted; if suppuration is present the leucocytes are usually over 20 000. In the early stages however a high leucocyte count means comparatively little but a maintained leucocytosis is a valuable sign of suppuration.

When gangrene of the appendix or part of it has occurred the early acute pain and cutaneous hyperæsthesia may disappear entirely and the patient may feel fairly comfortable the pulse is however usually rapid and the general appearance bad there may also be well marked local rigidity.

(iii) **Obstructive Appendicitis**—Wilkie has recently drawn attention to a distinctive group of appendicitis caused by complete block of the lumen of the appendix due to linking, band, or stercolith. The patient is seized with pain and tenderness in the right iliac fossa and vomiting, there may be no rise in the pulse rate or temperature in the early stages, but examination reveals a local rigidity and tenderness which does not correspond with the constitutional symptoms.

Immediate surgical treatment is called for in these cases as perforation is liable to occur at any moment, with a spreading generalized peritonitis.

(iv) In the graver forms of diffuse or generalized peritonitis, the onset is usually sudden, the patient becoming collapsed with the severity of the pain, vomiting often accompanies the outbreak and occasionally a rigor. These symptoms sometimes pass over directly into those of generalized peritonitis, as described, death ensuing in two or three days, the temperature in such cases may be low, and the absence of reactive phenomena is indicated by a *leucopenia*. In the *sero purulent* type the course is not quite so acute, the pain, which at first is referred to the umbilicus, becomes localized to the right iliac fossa, the abdominal wall on that side is held rigid, and the rigidity gradually spreads across the abdomen to the left iliac region and upwards towards the liver, vomiting and absolute constipation are present, and the temperature is usually raised three or four degrees, the pulse varies from 100 to 120 and the amount of urine passed is diminished in quantity. If surgical treatment is not undertaken early, the typical phenomena of acute diffuse peritonitis are soon developed.

(v) **Relapsing Appendicitis** is the term applied to a condition when an attack passes off, but not quite satisfactorily. There may be a slight persistent rise of temperature at night, or the appendix remains palpable and tender, or some amount of appendicular pain, often of a colicky character, may be present. Many of these cases are due to unhealed ulceration of the mucous lining or to stenosis of the tube. If left alone, a more acute outbreak may supervene, or bacterial invasion of the vessels in the meso appendix may follow, and serious consequences develop.

(vi) **Recurrent Appendicitis** is characterized by repeated attacks of varying gravity in an individual who has been once the subject of the disease. They may occur only at prolonged intervals, or be so frequent as entirely to incapacitate the patient, and are usually associated with the presence of some abnormal adhesion or constriction. It is not uncommon for the appendix to become fixed to the sheath of the *psoas* muscle, and then any excessive movements of the limb may light up an attack. Where stenosis exists, secretions containing bacteria may be pent up and from time to time the patient suffers from severe pain of a colicky nature, with or without fever, probably due to an attempt to get rid of the excess of mucus. Such attacks have been named *appendicular colic*. In a few cases the appendix becomes totally obliterated after a time and incorporated in a mass of adhesions, a natural cure being thus established, more frequently, the patient finally develops an acute attack which demands operation.

(vii) *Appendicular Gastralgia* is the name applied to cases in which all the signs and symptoms of the disease are referred to the epigastrium and closely mimic those of a gastric or duodenal ulcer. The patients are usually women and a test meal examination reveals a hypersecretion of gastric juice in which the hydrochloric acid is usually increased. Laparotomy shows no lesion in the stomach or duodenum but chronic appendicitis is present. That the previous symptoms were due to the appendix is proved by the relief to the symptoms and the changes in the gastric secretion after appendicectomy. Not unfrequently these patients are also the owners of a movable and tender right kidney.

On the other hand it must not be overlooked that a gastric or duodenal ulcer is often accompanied by pain referred to the right iliac fossa and many an appendix has been removed without benefit to the patient for these conditions. The history of the case must be most thoroughly investigated. Pain in gastric or duodenal lesions is more persistent than in appendicitis and the intervals of freedom between attacks shorter. Vomiting too is less marked in appendicitis and does not give the relief experienced in duodenal lesions.

Diagnosis—In a well marked case the symptoms of appendicitis are so typical that the diagnosis can never be in doubt. The pain, tenderness, fever, vomiting, constipation, abdominal rigidity and perhaps swelling constitute a picture that is quite characteristic. The disease however often presents symptoms so varied and manifestations so protean that one is never surprised to meet with it in all sorts of diverse settings.

The early stage of *pneumonia* is sometimes associated with severe pain and tenderness in the iliac fossa especially in children and the resemblance to appendicitis is the more marked when the onset is sudden and abdominal rigidity and vomiting are present. The abdominal symptoms are probably due to the existence of a diaphragmatic pleurisy. It will be noted that the pain is superficial and that deep pressure is painless if made carefully. The leucocyte count too is usually higher than in appendicitis. A careful examination of the lungs should never be omitted in the case of children with suspected appendicitis. The diagnosis is sometimes helped by turning the patient over to the left side. In a case of appendicitis gripping abdominal pain is complained of. If the lesion is thoracic the patient coughs. Cases which commence with diarrhoea may be mistaken for *enteric fever* but the absence of the rash and a blood examination should guard the practitioner from error. *Acte pyelitis* too sometimes simulates appendicitis but as a rule the temperature is higher, the abdominal muscles are relaxed, the tenderness is placed deeply in the loin and pus and bacteria are present in the urine. Occasionally however the appendix is in close contact with the ureter as it crosses the brim of the pelvis and then haematuria and even renal colic may be caused. In such cases the renal region is free from tenderness and the pain is situated at a lower level.

Perforation of the duodenum or even of the stomach may lead to symptoms very similar to those of acute appendicitis due to the inflammatory mischief tracking downwards. The initial pain will

usually be referred to the upper part of the abdomen and there may be evidence of free gas in the peritoneal cavity. If gas escapes from the abdomen on operation and is free from odour the probability is that the lesion is gastric or duodenal. *Mucous colitis* simulates chronic appendicitis and the appendix is indeed often involved in the mischief. The distinction is made by the tenderness being located over the whole course of the colon and by the passage of mucus in the stools. *Tubal* and *ovarian* diseases are recognized on pelvic examination but the fact must not be overlooked that chronic appendicitis is often associated with inflammation of the right ovary and then attacks of pain may occur at each menstrual period. A small ovarian dermoid with a twisted pedicle may resemble appendicitis very closely in the absence of a vaginal or rectal examination.

A considerable swelling in the right iliac fossa may result from repeated attacks due to a matting of the parts together and a diagnosis from tuberculous or malignant disease is sometimes difficult apart from operation. The history may be spread over a longer time however in appendicitis.

The diagnosis from acute obstruction is noted hereafter.

The **Prognosis** is never absolutely certain for the initial symptoms are frequently alike in all varieties and hence one can never know what course the case is going to take. As particularly bad signs in an acute attack may be mentioned a continued high temperature in spite of rest and careful dietetic measures a fall of temperature with increased rate of the pulse or persistent hiccough. The existence of a swelling in the iliac fossa is not a bad sign but rather the reverse. Absence of a localized swelling is due either to a defective formation of protective adhesions or to the appendix being placed behind the cæcum.

Treatment—Formerly perityphlitis was the exclusive property of the physician but nowadays appendicitis is more justly within the realm of the surgeon at any rate a surgeon should always share the responsibility of treatment with the physician since at any moment complications may develop even in cases which appear to be simple when immediate surgical assistance will alone hold out any hope of saving the patient.

1. In the mild catarrhal type of appendicitis where the temperature does not run above $101^{\circ} F$ and the symptoms are not severe all that is required in the majority of cases is to put the patient to bed and apply fomentations locally. the lower bowel should be emptied by an enema after a rectal examination has determined that no pelvic complication is present. A fluid unstimulating diet is ordered and should there be much vomiting rectal alimentation may be required. Morphine may be given to quiet the patient and check peristalsis thereby facilitating the formation of protective adhesions but the less the better since it tends to mask symptoms.

The question of operation for this mild type of disease can be readily compressed into the three following propositions.

(a) If the condition is not showing signs of improvement at the end of forty-eight hours i.e. on the third day in spite of appropriate

treatment the case should be looked on as probably one in which suppuration is occurring and operation is desirable.

(b) If the appendix remains tender and palpable after an attack and especially if the temperature rises slightly at night, the organ should be removed without delay.

(c) As soon as the attack is really quiescent i.e. generally in nine to ten days the appendix should be removed. This proposition is now generally accepted and it is absolutely logical. In the first place recurrence is common and the figures given above i.e. 30 per cent probably under-estimate its frequency. Then too it is impossible to tell which cases will recur and which escape whilst the recurrent attack is frequently more severe than the first and often accompanied by suppuration. Moreover each recurrent attack is likely to add to the adhesions present so that whilst removal after a first attack is an easy proceeding removal after many recurrences may necessitate a troublesome dissection. Finally it may be necessary to keep the patient very quiet and to limit his diet and his activities considerably if recurrence is to be avoided and such practice in a bread winner may be a serious matter.

Operation in the Quiescent Period—The muscle splitting plan suggested by McBurney may well be adopted when it is probable that but few adhesions are present. The incision is transverse or oblique about 2 to 3 inches long crossing McBurney's spot or a little below it and parallel to the outer end of Poupart's ligament. The external oblique is incised in the course of its fibres and the divided segments are held well aside. The fibres of the internal oblique and transversalis muscles are separated in the direction of their fibres.

The introduction of large deep retractors will expose a square or diamond shaped area of subperitoneal fat or peritoneum about 1½ to 2 inches in diameter. Should this space be insufficient the incision is carried inwards and the rectus sheath opened the muscle is drawn inwards by a suitable retractor and the sheath back and front freely incised. The peritoneum is divided transversely and the margins grasped for identification purposes. The cæcum probably presents and is gently withdrawn. The anterior longitudinal muscular band conducts to the appendix which is freed from adhesions and removed. The meso-appendix is first divided after securing its vessels. A crushing clamp is applied to the base of the appendix and when it is removed after a few seconds there is only a thin tube of the serous coat (Fig. 746) which is ligatured with catgut and divided with a carbolized knife just beyond the ligature. To prevent leakage of the contents before cutting off the appendix its proximal end is seized with artery forceps. A purse-string suture is then introduced through the serous and muscular coats of the cæcum around the base of the appendix which is gently invaginated into the cæcum by a pair of forceps and the suture tied by this means the stump of the appendix is completely buried (Figs. 746 and 747). The site of detachment of the meso-appendix or of the position from which the appendix itself has been detached may require a few sutures in order to ensure a complete peritoneal coating and thus minimize the risk of subsequent adhesions. In females it

is always well to explore the right ovary and tube before closing the abdominal wound

If it seems probable that many adhesions are present the muscle splitting operation should be avoided and the abdomen should be opened by a good sized paramedian incision or by dividing the whole thickness of the abdominal parietes in the line of the fibres of the external oblique so as to allow the wound to be enlarged up or down as may be desired. This oblique incision is also useful in simple cases if the surgeon is careful to make only a *small* section of the internal oblique and transversalis muscles one limited to an inch and a half is quite ample in most cases and no risk of hernia is thereby run if the muscles are carefully sutured

In the more serious cases the patient should remain in bed for three weeks to allow the bond of union to become firm and avoid all need

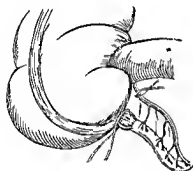


FIG 746 —REMOVAL OF THE APPENDIX
A ligature is placed on the meso-appendix and the base of the appendix crushed and tied

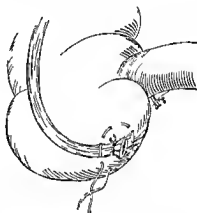


FIG 747 —SERO-MUSCULAR PURSE STRING SUTURE INSERTED TO INVAGINATE THE STUMP

less strain for some months but in the simpler cases he may be allowed up in a fortnight. Pain in the wound or stretching of the scar is obviated by careful strapping

2 In the gravest variety of *fulminating appendicitis* associated with diffuse septic peritonitis the only hope of recovery lies in immediate operation. When the peritonitis is extensive and the exudate purulent this hope is but slender in the extreme if however the effusion is mainly pelvic and still of a sero purulent type a considerable percent age of the cases may be saved. Hence whenever the attack starts with severe pain frequent vomiting and early collapse whilst the abdomen though not distended shows marked signs of rigidity and especially if on the left side operation must not be delayed. In such cases the appendix is either gangrenous or perforated and then every hour adds to the mischief or it is acutely distended with muco-pus and may perforate at any moment giving rise to a general infection

The abdomen is opened either by a paramedian incision or in the right iliac fossa the appendix is looked for and removed and effusion if present is swabbed away. Drainage may be omitted in some of the early operations even if effusion has been present but in most instances it is necessary and may then be provided by tubes or gauze wicks.

Investigation as to the part played in these cases by anaerobic organisms has resulted in the practical suggestion that all such patients should after operation receive intravenous injections of 40 to 60 c.c. of *B. perfringens* (H. Welchii) antitoxin diluted in saline solution.

3. When a *localised intraperitoneal abscess* is evidently pointing as indicated by fluctuation or commencing oedema of the abdominal wall (a condition that ought never to be seen) it is often possible to open the abscess without encroaching on the general peritoneal cavity. The pus is then allowed to escape and the interior very gently explored with the finger. If the appendix is easily felt it may be removed but no attempt to search for it is justifiable. A drainage-tube is inserted and the wound allowed to heal in the ordinary way. At a later date the appendix may be removed and often with very little difficulty as but few adhesions may be present.

4. There is still however a large group of cases in which none of the above conditions is manifest and yet the symptoms both local and general indicate that a lesion of considerable gravity is present. The attack may have commenced more or less acutely but has progressed steadily. Much difference of opinion has existed as to the desirability of operation in these cases and especially as to the most favourable time for such a procedure. It must be admitted that in many instances conservative or medical treatment will suffice to bring about a satisfactory result but this can never be depended on and unfortunately the experience of all surgeons is that only too frequently have they been called in to operate on patients who have been brought into the gravest jeopardy of their lives through undue delay. Operation under such circumstances is always risky and even if the local conditions are effectively dealt with the patient may subsequently succumb to toxæmia, septicæmia, pulmonary embolus or other manifestations of blood poisoning.

The objections usually raised to early operation are that it involves the removal of the appendix from a certain number of people who might get well without operation and that it is not the best time to operate when inflammatory phenomena are present. The answer to these objections is quite obvious viz. that the prognosis in any case is so hopelessly uncertain that the risks involved in waiting for a quiescent interval on the one hand or for the development of undoubted indications of the presence of pus on the other are much greater than those of an operation undertaken at an early date by a skilful surgeon. Moreover an appendix that has once been inflamed is of no service and may be a source of grave danger to its possessor and the sooner he is rid of it the better. Extensive experience of the early operation proves that pus is frequently present at quite an early stage of the affection i.e. within twenty-four hours or less.

and one rarely operates on any case where the symptoms are at all severe without finding cause for gratification that delay had not been counselled. Moreover statistics prove that the mortality associated with operation during the inflammatory attack is much less when it is undertaken on the first day (12 per cent) than on any of the successive days up to the sixth or seventh. The chief advantages of an early operation may be indicated as follows (a) That the patient is not in a state of collapse from toxæmia and hence can well stand the shock of an intraperitoneal exploration (b) that the amount of effusion likely to be present is small and thus can be easily dealt with and safely removed with but little risk of infecting the general peritoneal cavity or the abdominal wall (c) that the appendix can usually be found isolated and removed without much difficulty in the later stages where a large abscess exists this may be impracticable and a second operation for its removal may be required later on and then the appendix may have to be dug out of a mass of adhesions and serious risks taken and (d) that a smaller incision will be required and hence there will be less likelihood of the subsequent development of a hernia. One would therefore claim that the following rule is both reasonable and justifiable and that its observance will be beneficial *viz* that in cases of moderate severity *if in spite of suitable rest and medical treatment the symptoms both general and local are not commencing to abate at the end of forty eight hours operation should be undertaken* and still more so if any of the following conditions indicative of the formation of an intraperitoneal abscess are existent *viz* a steady rise in the leucocyte count or one above 20 000 especially if maintained for twenty four hours persistent distension of the abdomen a maintained high temperature hiccough or a continued high pulse rate in spite of a falling temperature. Of course a localized swelling which persists or increases in size and becomes more tender will also indicate operation.

5 Not a few cases will be observed in which the initial symptoms quiet down at the end of twenty four or forty-eight hours but after an interval of quiescence of varying length the phenomena suggestive of suppuration show themselves. In such patients operation should be advised immediately as an abscess is obviously developing.

An exception to this rule is possibly to be made in the case of small children. Experience has shown that when operation for acute appendicitis is undertaken between the third and sixth days in children things often go well for twenty four to thirty six hours but then a sudden change for the worse takes place characterized by a fall of temperature rise of pulse and general irritability followed by drowsiness persistent vomiting and finally coma and death. These cases have usually been attributed to delayed chloroform poisoning but there is little doubt that not a few of them are really of septicæmic origin due to the absence of protective antibodies in the blood. When ever possible operation in children should be put off until after the sixth day if not undertaken before the third.

Operation for Suppurative Appendicitis—Ether or spinal analgesia should always be the anæsthetic if possible the mortality after opera-

tion when chloroform is employed is decidedly higher. The incision will vary with the physical signs and the site of maximum tenderness. The whole thickness of the abdominal wall is divided and it is well to make a sufficiently large opening, an extra inch of incision may make all the difference between blindly groping in the dark and seeing clearly what one is doing. The general arrangement of the parts is noted and the peritoneal cavity protected from purulent infection by packing with sterilized gauze, one strip is usually passed upwards along the ascending colon, one downwards into the pelvis and one internally to protect the small intestines and general serous cavity. The cæcum is then gently lifted from its bed and the abscess will usually be found behind or below it. Every effort must of course be made to prevent soiling of the unaffected peritoneum. Whenever possible the appendix should be removed, but not unfrequently a formal amputation is impracticable. A catgut ligature is then tied around the base about $\frac{1}{2}$ inch from the cæcum and the appendix cut away, the stump is guarded by a gauze strip or strip of rubber passed down to it from the wound and used for drainage. Not unfrequently however the appendix does not appear and then it may be better to leave it alone, in many cases however an experienced surgeon will be able to detach and remove it. The cavity is emptied of pus by swabbing it out and a careful but thorough exploration of the pelvis and right kidney pouch made to ensure that pus is not shut up in these regions. Finally the cavity is packed in such a way as to drain it thoroughly and yet to protect the surrounding parts. The abdominal incision is partially closed.

The packing is gradually removed in the next two or three days and after the general cavity has been shut off by the development of adhesions irrigation with salt solution or peroxide of hydrogen is permissible. The wound heals by granulation and when nearly flush with the surface may be drawn together by strapping so as to limit the chances of development of a ventral hernia.

A *Ventral Hernia* sometimes follows from the yielding of the cicatrix in the abdominal wall after an abscess has been opened and drained. Both omentum and bowel perhaps matted together and adherent to the cicatrix are found in the protrusion. In some cases it may suffice to protect and restrain it with a truss, but in others operation is required, adhesions must be divided or broken down and often the opportunity can be taken for removing the appendix if this has not already been accomplished. The margins of the divided muscles are then sought for and united by a row of buried sutures in the ordinary way or overlapped as described in discussing the subject of ventral hernia.

Tuberculosis of the Appendix is found not uncommonly in patients who have died of other manifestations of the disease, especially phthisis (30 per cent. Keen), it is not often seen as an independent condition but most frequently comes under observation in men between the ages of twenty and forty who are the subjects of urino-genital tuberculous disease. The affection may develop as an ulceration of the mucous membrane which slowly spreads from the tip and destroys the walls of

the organ, giving rise finally to a large pericæcal abscess which opens into the bowel or discharges externally. In other cases the condition is merely an element in the evolution of the hyperplastic tuberculous growth of the cæcum described elsewhere. Occasionally the appendix is involved in a tuberculous peritonitis, and then the trouble may either have started in the appendix, or have reached it secondarily from the serous coat. The symptoms of these conditions are in no way peculiar, and correspond to those of a chronic appendicitis.

Actinomycosis attacks the appendix, together with the cæcum more frequently than any other abdominal organ. The disease usually originates from the ingestion of infected material, and the result is the production of a hard, slowly enlarging mass, infiltrating the tissues in the right iliac fossa. Sooner or later the skin gives way, and then the discharge of glairy pus and of the yellow sulphur like granules, together with the musty smell is pathognomonic. Pyococcal infection of the sinuses is only too likely to follow, some times originating from within the bowel and the case then becomes complicated by a suppurating element, which has an important bearing on the result. Secondary foci are common, especially in the liver. Treatment consists in excision of the appendix, and even of the cæcum, if such be practicable and in the exhibition of large doses of iodide of potassium with curettage and drainage, but even when the organisms have been destroyed by the drug, the discharge of pus may continue, and the affection may prove fatal.



FIG 748—LOW POWER DRAWING OF A SECTION THROUGH THE TIP OF AN APPENDIX SHOWING HOW A CARCINOID TUMOUR FILLS THE LUMEN

Tumours of the Appendix are uncommon, but more would be discovered if every appendix that was removed was submitted to microscopical examination. Carcinoma is rare, and behaves like a carcinoma of the bowel, forming metastases which cause death of the patient. Carcinoid tumours are not uncommonly found in the appendix and are usually situated towards the free extremity of the organ quite often forming a rounded bulbous tip to the appendix. In some cases, however, they are to be found near the base of the appendix, when they have a tendency to cause diverticula of the appendix, and, at times even acute appendicular obstruction. These carcinoid growths present an alveolar structure which is quite like a cancer (Fig 748). They may be so minute that they cannot be seen by the naked eye, and are only discovered accidentally on microscopical examination.

The cells of these carcinoid tumours are somewhat small, arranged in irregular masses in the submucous coat and extending in places into the other coats of the appendix (Fig 749). There are in the cells,

minute granules which have the power of reducing silver salts, and hence they are called 'argentaffine' cells. It is because of this that some pathologists have called such tumours of the appendix 'argentaffine tumours'. It is most uncommon for any metastases to occur, and carcinoid tumours may be looked upon as benign growths.

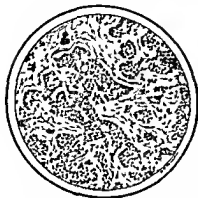


FIG 749—MICROSCOPICAL DRAWING OF A CARCINOID OF THE APPENDIX SHOWING THE SMALL CELLS ARRANGED IN MASSES

Affections of the Liver

Displacements of the Liver are obviously not likely to be common since the organ is well supported both by ligaments and attachments to deep structures and by the intra abdominal pressure. Should however the abdominal

parietes be relaxed and the intra abdominal pressure lessened it is possible for the liver to sink, and thus *hepatoptosis* becomes an element in the syndrome known as Glénard's disease. The displaced liver is rotated forwards so that its upper wall presents anteriorly with obvious resulting physical signs. An enlarged liver may manifest somewhat similar phenomena but dulness is then found over the normal hepatic area, in *hepatoptosis* the normal site is resonant. Some amount of dragging pain and discomfort may be complained of but this is not generally great enough to demand treatment other than the support of a belt together with such measures as shall assist in the restoration of the abdominal wall to a state of normal tonicity.

Riedel's lobe is the name applied to a fingeriform enlargement of the right lobe which projects downwards into the loin and is likely to be mistaken for a floating kidney. It is frequently associated with an enlarged gall bladder probably containing stones which is covered in by the projection. The lobe may have a broad base of attachment to the liver or may be almost severed from it, and then its mobility is considerable and may be independent of the liver. A little care in examination should enable the surgeon to differentiate between this condition and a floating kidney if the patient be laid over on the left side the examining hand can be insinuated between the lobe and the kidney. Treatment is not required except for the condition of the gall bladder.

Rupture of the Liver is produced by injuries to the abdominal walls such as blows, kicks or crushes or it may be torn by the broken end

of a rib. Penetrating injuries also occur, as from sword or dagger thrusts, and the organ may be involved in a gunshot wound. The resulting lesion varies considerably: the gland may be merely torn or contused from a non-penetrating blow, or freely incised by a sharp-cutting implement in which case some of the larger venous trunks are likely to be divided: a bullet sometimes produces almost total disorganization. The amount of injury depends to some extent on the condition of the organ, if it is firm and sclerosed, it may receive little damage from a blow which would otherwise do it considerable harm: whilst if it is enlarged and fatty, it is readily torn.

The chief symptoms are shock, which is often not very excessive, pain and tenderness in the right hypochondrium and the evidences of loss of blood. The last is, perhaps, the most important, and upon its severity depends to a large extent the result. Should the capsule remain intact, there is considerable intraglandular ecchymosis and a laceration, but no free blood escapes into the peritoneal cavity, such a lesion is not unlikely to be followed by an abscess of the liver. When the capsule is torn, intraperitoneal hæmorrhage and escape of bile are sure to ensue, if slight the patient, though suffering from all the phenomena characteristic of loss of blood may recover, the blood being absorbed, and the wound in the liver cicatrizing. This process is usually attended by a certain amount of jaundice and some vomiting, whilst the urine is also tinged with bile pigment. Well marked pyrexia may follow the initial shock and the abdominal wall is held rigid. The blood collects at first in the upper part of the abdomen but gradually extends downwards: not uncommonly there is some associated injury of the gut wall, through which intestinal bacteria find their way, giving rise to a localized or general peritonitis. In the more severe lesions, where perhaps the left lobe is entirely torn off or a portion hopelessly contused, death from hæmorrhage is almost certain to ensue in a very short time.

The diagnosis of hepatic rupture turns mainly on the history of the accident, the situation of the blow, and the resulting symptoms. Evidences of intraperitoneal bleeding, associated with pain in the right side, are extremely suggestive. It must not, however, be forgotten that much shock, considerable local pain, and tenderness may be caused by an injury, and yet the liver may have sustained no serious damage.

The treatment in the more simple cases consists merely in careful expectancy, the surgeon holding himself in readiness to interfere should any untoward symptoms supervene. The patient is kept quietly in bed, ice may, if necessary, be applied to the side, the diet is limited to fluids, and the lower bowel emptied by enema. In the more serious cases, where the diagnosis of ruptured liver is tolerably certain, an exploratory laparotomy should be undertaken, and an attempt made to deal with the wound (Figs 750-753). Quite a number of wounds occur on the under surface of the liver, and it is most important that this surface should be explored carefully. The surgeon's left hand is inserted into the abdomen and the liver grasped and

The Symptoms are in some instances extremely slight, the patient perhaps dying of peritonitis due to its rupture without its presence having been ever suspected, or retaining the pus encapsuled for years. The individual usually complains of a sense of pain and fulness in the right hypochondrium, and in the more acute cases this may be accompanied by severe pain and focalized tenderness over the whole hepatic region, the pain being also referred to the right shoulder. When the pus encroaches on the upper surface of the liver, a cough on taking a deep breath is rather characteristic. A certain amount of febrile disturbance occurs, the degree of which depends on the rapidity of formation of the abscess, in the more acute forms the temperature is high and rigors may be present, in the more chronic variety there is some fever in the evening, and night sweats occur. The pyrexial phenomena are associated with loss of appetite, rapid and well marked emaciation, and perhaps a slight amount of icterus. On physical examination a more or less evident enlargement of the liver will be detected, but there is neither fluctuation nor a sense of elastic tension unless the abscess is very superficial. The dullness often extends up towards the thorax rather than downwards, though the contrary obtains when the abscess is situated not far from the free margin of the liver.

Left to itself the abscess may become adherent to the anterior abdominal wall and point in the epigastrium, its onward passage being indicated by congestion and œdema of the parietes, or it may open into the peritoneal cavity, or into one of the hollow viscera, such as the colon or duodenum, or, again, it may travel upwards, burrowing through the diaphragm and either bursting into the lung, its contents being expectorated, or into the pleural cavity, leading to an empyema. Occasionally it remains passive as a chronic encysted abscess, and then the walls become very thick.

In many cases the diagnosis of suppuration is by no means easy, and mistakes are often made, the condition being looked on as one of simple hepatitis. A history of dysentery is of great importance, and assistance may often be afforded by an examination of the stools, as, although the amœbæ themselves are only present in the acute stage, the resting or encysted forms may persist for long periods. These are spherical, refractile bodies containing four nuclei, and must be carefully distinguished from the cysts of the *E. coli*, which are usually oval, and may contain up to eight nuclei. A blood-count may also help, and especially a differential count, but sometimes it is of little value, since a leucocyte count of 20 000 or more can occur without suppuration. A marked increase in the polymorphonuclear leucocytes, together with a diminution in the small lymphocytes is always suggestive of the presence of pus, due to pyogenic organisms, in a pure amœbic abscess, leucocytosis occurs with a comparatively small increase of polymorphs. A doubtful diagnosis can sometimes be confirmed by the aspirator or exploring syringe, but this should not be utilized unless one is fully prepared for immediate operation in the case of pus being found. Manson directs that the aspirator needle should be introduced in the following situations (1) In the right axillary line through the seventh or

eighth costal interspace (2) just below the ribs in the right nipple line, (3) immediately below the lung in the line drawn downwards from the angle of the right scapula. Some recent work suggests that the injection of a dye (thorotrast) may be of use in the X ray diagnosis of these cases but there are considerable risks attendant on its use.*

Treatment.—It is important to realize the prophylactic value of emetine in the early treatment of amœbic dysentery, as it is found that the patients who have been given this drug during the acute stage of the dysentery show only a comparatively small proportion of liver abscesses. In the acute stage of amœbic hepatitis, moreover, injections of emetine (0.06 grm. daily) will often succeed in determining resolution without suppuration. At a later date it is also probable that treatment by emetine will turn an amœba-containing abscess into a sterile cavity and thereby permit of the absorption or encapsulation of the pus, cases of this type are on record. In the majority of patients, however, operation is necessary but if time permits, a prophylactic course of emetine is desirable.

Aspiration repeated once or twice, has been frequently employed, and with some success when preceded by a course of emetine, but apart from this it is possible to determine an attack of septic peritonitis or pleurisy from infection through the needle puncture. It has also been suggested by Sir Leonard Rogers that inasmuch as the entamœba is easily killed by comparatively weak solutions of quinine, all that is needed in amœbic abscesses is to aspirate the cavity and then introduce 30 to 40 grains of bi hydrochlorate of quinine, and employ no drainage. The results hitherto have been encouraging. A rapid microscopic examination of the pus should be made at the time, and if organisms other than the amœba are found, the ordinary operation can be carried out at once.

The practice usually followed is in accordance with the surgical law of treating suppuration, *viz* by *incision and drainage*. If pointing in front and adherent to the parietes there is no difficulty or danger in making an incision over the most prominent spot and laying the cavity open, it is then well flushed out and a drainage-tube inserted. If on dividing the abdominal parietes it is found that the liver is not yet adherent, precautions must be taken similar to those employed in dealing with the intraperitoneal abscess connected with appendicitis. The general serous cavity must be carefully walled off by sterilized gauze before letting out the pus which is of course done slowly, and the assistant must keep the parietes in close contact with the hepatic tissue. It may be possible to insert a few stitches through the liver substance, securing it thus to the parietal peritoneum, otherwise one must trust to careful packing. After opening the abscess, it is usually advisable to wash it out, and this may with advantage be repeated subsequently. A large drainage tube is inserted, and packed around with gauze to prevent purulent extravasation.

When the abscess is in its most common situation, *viz* the back of the right lobe, it is often most satisfactory to open it from the side,

* Hepato Lienography by the Aid of Thorotrast *Quarterly Journal of Medicine*, January, 1933

a similar proceeding is sometimes needed when an abscess has been opened from the front and does not drain properly. An incision is made a little behind the mid axillary line through the ninth or tenth intercostal space and a portion of one of the adjacent ribs removed. The pleural cavity is opened and the costal pleura stitched carefully to that portion which covers the diaphragm. It will be found that this structure lies nearly vertical in this position and but little difficulty is experienced in shutting off the general pleural cavity. The diaphragm is then divided and not unfrequently the peritoneal cavity is opened. It must be carefully protected by gauze packing and then the liver is incised. Less commonly adhesions may have already formed or a bare area of the liver may be found through which the pus can be with drawn and the abscess opened. The progress of these cases is often most satisfactory if effective drainage is maintained. Occasionally without any obvious reason healing is delayed and suppuration persists. This is sometimes due to a re-absorption of amœbæ from the bowel and it may be desirable under such conditions to administer a suitable course of emetine.

Hydatid Cysts occur in the liver more frequently than in any other part of the body. For general details as to the life-history of the *Tania echinococcus* and the structure of hydatid cysts see p. 240. They produce a localized painless enlargement of the liver the cysts varying in size from a small marble to a child's head. The outline is well defined if superficial but not so if placed deeply. The cavity is usually filled with fluid and daughter cysts. Fluctuation may be distinguished and a hydatid fremitus or thrill (arising from the concussion of the contained daughter cysts) may, it is said, be elicited on palpation. The diagnosis is easily made if the cyst projects from the lower border but when deeply embedded in the organ it may be exceedingly difficult and the tumour can only be distinguished with certainty from carcinoma or syphilis by the use of the aspirator or preferably by an open exploration. The character of the fluid withdrawn from a hydatid cyst is at once conclusive as it is of low specific gravity, slightly opalescent with no albumen and a trace of salt. The presence of scolices or hooklets (Fig. 91 p. 240) is the pathognomonic feature.

Terminations—The cyst may remain latent and innocuous or may actually dry up and form a mass somewhat like wet mortar owing to the death of the organism or it may burst and be evacuated in different directions with or without suppuration. Thus it may open externally through the abdominal parietes or into the peritoneal cavity causing fatal shock and in many cases peritonitis or into the stomach or intestines spontaneous cure usually resulting or it may penetrate the diaphragm and the contents be expectorated or set free in the pleural cavity causing a rapidly fatal pleurisy. It has been known to open into the pericardium or even into the hepatic veins the contents then being impacted in the right auricle in both cases immediate death resulted.

Treatment—The best plan of dealing with a hydatid cyst is to lay it open either through the anterior abdominal wall or through the costal parietes and diaphragm to empty it of its contents and if

possible to enucleate the lining wall or ectocyst which is often but loosely connected to the granular endocyst. This is usually accomplished at one sitting. Similar precautions as to protecting the peritoneum are taken as for an abscess. When the surface of the liver is exposed it is advisable to puncture the cyst first with a trocar and cannula so as to reduce the tension within it. It is then incised freely and the loose daughter cysts removed. This is facilitated by flushing out the cavity with sterilized salt solution. The endocyst is removed either by enucleation with the fingers or a blunt dissector or it may be possible to detach it by irrigation the nozzle of the irrigator being inserted beneath it. If enucleation is completely successful the lesion in the liver may be closed and the abdominal wound sutured in the ordinary way without drainage (Hamilton Russell) dependence being placed on the aseptic organization of the blood clot which fills the cavity in the liver. If for any reason this seems undesirable a gauze packing is introduced into the cavity and healing by granulation is allowed to proceed. If however part of the lining wall is left a drainage tube must also be introduced and the cavity subsequently irrigated at each dressing.

No attempt should be made to remove the fibrous ectocyst as it is closely connected with the liver substance and grave hæmorrhage might follow any interference with it.

A suppurating hydatid cyst is dealt with according to the same rules of treatment as hold good for abscess of the liver.

Tumours of the Liver are rarely primary. *Adenomata* develop as sharply defined masses usually in the right lobe and only cause symptoms by their size and weight. In some cases suitably situated removal is quite possible. *Angiomata* may be similarly localized but their removal is rarely feasible on account of their size and in that they are likely to be multiple. *Carcinoma* may be primary and removal practicable but one can never be certain that secondary nodules impossible to recognize are not already in existence. Extension of malignant disease of the gall bladder to the liver may tempt the surgeon to undertake removal but it is almost certain that when once the disease has spread outside the gall bladder it has developed in directions other than that which is visible and removal will be useless. Secondary tumours are common and follow a carcinoma of the intestinal canal especially of the stomach or large intestine (Fig. 754) or perhaps may be a sequel of cancer of the ovary, uterus or breast. The liver is also involved secondarily in melanotic disease of the skin or retina. In all these cases the organ becomes enlarged and its surface irregular due to the projection of nodular masses of the growth. In cancer they are frequently more or less umbilicated. Pain is not generally a prominent symptom but ascites and jaundice develop in malignant cases from pressure on the portal vein and biliary ducts in the portal fissure and cedema of the legs may be caused by compression of the inferior vena cava.

Gummata are developed in inherited and acquired syphilis and are of sufficient size to need careful diagnosis from the more serious growths which develop in the liver. They are single or multiple and occur in

the form of rounded, yellowish, non vascular masses, which caseate, and are surrounded by much fibrous tissue. Absorption is followed by considerable cicatrization, which leads to deformity. The diagnosis from secondary carcinoma is not always easy. The history of the patient must be carefully considered, and if any doubt arise, the Wassermann reaction is tested. Carcinomatous growths have hard umbilicated surfaces (Fig 754), if they can be felt, enlarge rapidly with marked cachexia, and early produce jaundice and ascites. Gummata are slow in their progress, do not generally affect the structures in the portal fissure, and may be associated with an enlarged spleen from lardaceous or gummatus disease. A course of antisyphilitic medicine will necessarily influence the case very decidedly.

Actinomycosis of the liver is usually secondary to an affection of the alimentary canal, particularly the appendix or transverse colon, or may be due to a direct spread of the infection. The liver is enlarged, and may be covered with adhesions. On section the affected area presents a trabeculated honey combed appearance, which has been compared to a sponge soaked in pus. There is much fibrosis around, and the trabeculae are markedly fibrous. The pus contains the characteristic granules of the fungus. The clinical history is that of an hepatic abscess, and the prognosis is bad. Treatment is as for the disease elsewhere.



FIG 754—LIVER CONTAINING MANY SECONDARY DEPOSITS.

The primary growth was in the stomach.

Affections of the Gall-Bladder and Biliary Passages.

The Gall-Bladder (Fig 755) is a pear-shaped sac lying under cover of the liver and projecting into the peritoneal cavity. Its average length is about 3 to 4 inches, and it is normally capable of holding about an ounce of fluid. An *enlarged* gall bladder projects downwards and towards the umbilicus, constituting a rounded swelling which moves with respiration, and is almost always in close relation with the anterior abdominal wall, it is freely mobile from side to side, and has attained such dimensions that it has been operated on in mistake for an ovarian cyst.

It is attached to the liver by reflections of the peritoneum which vary somewhat in their insertion, as a rule, about a fifth of the circumference of the gall bladder is in contact with the liver. The attachment is loose, and when once the right layer has been reached it is easy to strip the gall bladder from the liver. The cystic artery reaches it at some distance from the fundus.

In a few cases the gall bladder has a complete peritoneal investment

swinging loose from the liver on a mesentery and in two cases the writer has seen serious colic develop apparently from this lax attachment much in the same way as a long appendix can cause appendicular colic. Removal of the gall bladder demonstrated the absence of stones and cured the condition. Such a condition may be termed *Gall Bladder Colic* to distinguish it from the biliary colic produced by gall stones. On another occasion *torsion* of the gall bladder was observed. The patient came into hospital for a supposed acute cholecystitis but on operation the gall bladder was found to be twisted around on its own hepatic attachment and to be practically gangrenous the symptoms had only lasted for twenty four hours.

The **Cystic Duct** is about 2 inches in length or rather less and is arranged more or less in a spiral fashion by the attachment of the peri-

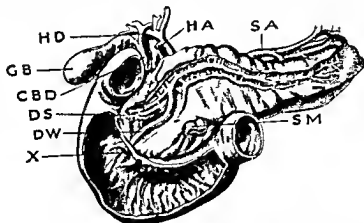


FIG 755 —DIAGRAM OF THE BILIARY PASSAGES AND THEIR RELATION TO THE DUODENUM WHICH HAS BEEN LAID OPEN AND PANCREAS

GB Gall bladder HA hepatic artery HD hepatic duct CBD common bile duct DS duct of Santorini DW duct of Wirsung X opening of common bile-duct and duct of Wirsung in the duodenum SA splenic artery SM superior mesenteric vessels

toneum. It will ordinarily permit of the introduction of a No 5 catheter but probably in a healthy state the mucous membrane is in such folds that a probe cannot be passed along it. The **Hepatic Duct (HD)** is 2 inches in length and is formed by the junction of the right and left ducts which issue from the liver at either end of the transverse fissure and unite together at a very obtuse angle. The duct passes down with the hepatic artery and a little above the upper border of the first piece of the duodenum is joined at a very acute angle by the cystic duct. The **Common Bile-Duct (CBD)** is about 3 inches in length and takes a No 7 catheter one inch or more of it is to be found above the duodenal border and then it dips behind the viscus and after lying between the inner border of the gut and the head of the pancreas it perforates the bowel obliquely (X) sometimes being distended just

before its termination to constitute the ampulla of Vater, and into this the duct or ducts of the pancreas also open

There are no known clinical or laboratory tests of the efficiency of the liver and its excretory apparatus. Radiography can only detect calculi if there is sufficient calcium in their substance (Plate XXIV). Recently however a method known as *Cholecystography* is used by means of which some idea of the gall bladder can be secured prior to operation. It consists in a radiographic examination of the gall bladder after the administration by mouth or intravenous injection of a suitable dose of sodium tetra iodophenolphthalein. The patient is prepared as for a barium meal by purgation and starvation and the dose is then administered if by mouth in gelatine capsules which will not dissolve until the intestine is reached if by the veins 4.5 grms dissolved in 40 c.c. of double-distilled water. The greatest care must be taken to prevent the slightest trace of this solution escaping outside the vein or sloughing and suppuration will inevitably occur. A radiograph of the right subcostal region is taken previously for comparison and again after intervals varying from twelve to twenty four or thirty six hours. Details of procedure vary much but the results are very promising. If there is no hindrance to the entrance of bile or to its escape from the gall bladder and if the organ is capable of carrying on its concentrating work normally then it becomes visible as a shadow owing to the presence within it of the drug which is opaque to the X rays (Plate XXIII). If on the other hand the excretory duct is blocked as by a calculus or malignant growth or if the part is incapable of undertaking its function as a concentrator of the bile no shadow will appear. Variations in the shape of the gall bladder may be detected when they are due to extrinsic causes such as tumours or adhesions and calculi may reveal themselves as a mottling of the shadow if the ducts are patent.

Rupture or Perforation of the Gall Bladder results from such injuries as blows crushes kicks etc. but it may also be produced by penetrating wounds or bullets occasionally it follows ulceration from within as from a large impacted gall-stone. Blood and bile escape into the peritoneal cavity. Pure bile is sterile but if any inflammation of the biliary passages has occurred organisms are sure to be present. If a considerable quantity of bile escapes suddenly into the peritoneal sac acute peritonitis is certain to follow sooner or later whether organisms are present or not. Slight jaundice arises from absorption by the peritoneum of bile which may also be found in the urine. A more gradual escape of the secretion will probably lead to the formation of a localized intraperitoneal abscess or collection of fluid associated with jaundice and possibly clay-coloured stools. In a penetrating wound bile and blood will escape on the surface and septic peritonitis is almost sure to follow. The prognosis of cases of perforation due to stone is always bad since the patient has probably been accustomed to severe attacks of pain and the change in type may not be recognized until too late.

The immediate symptoms are those of shock and severe hypochondriac pain and this will be succeeded either by acute peritonitis or by the formation of a localized intraperitoneal swelling together

PLATE XXIII



NORMAL CHOLECYSTOGRAM (ORAL METHOD)

The gall bladder fills normally and no gall stones are present. This does not however exclude cholecystitis since we depend on the filling of the gall bladder to show non-opaque gall stones (the result of chronic cholecystitis).

PLATE XXIV



GALL STONES

Note the facets on the shadows also their dense periphery and less opaque centres due to the deposition of lime salts on the cholesterol gall stones

with mild jaundice. When the existence of such a lesion is suspected Treatment always consists in an exploratory laparotomy. The condition has probably been diagnosed as one of perforated gastric or duodenal ulcer, and it is only the character of the exudate that calls attention to the biliary passages. Should only a small injury be found in the gall bladder it is perfectly feasible to close it by sutures, a gauze wick should, however, be passed down to the lesion for a few days, so as to provide a means of drainage should leakage occur. A more serious rupture necessitates removal of the gall bladder. Should the common bile duct be entirely divided the ends may be united by suture, but in grave cases, where the gall bladder is undamaged and healthy, it may be wiser to close the ends completely and undertake a cholecystenterostomy.

Inflammation of the Biliary Passages is of frequent occurrence, and generally arises as a sequela of gastro-duodenal catarrh. The affection is similar in nature to that commonly seen in other tracks lined with mucous membrane, and may be limited to the main bile ducts and their extensions into the liver (*cholangitis*) or may also involve the gall bladder (*cholecystitis*). The catarrh is determined by the presence of micro organisms, and streptococci, staphylococci, or the *B. coli*, are most frequently present. The condition may be limited to a simple catarrh, or suppuration may follow.

Catarrhal Cholangitis is of frequent occurrence and presents two chief clinical types the acute and the chronic. In the acute form it is common in young people, arising from over eating or injudicious food, combined perhaps with exposure to cold and wet. The patient feels ill perhaps shivers looks a little sallow, or maybe is actually yellow (*catarrhal jaundice*). Abstinence from all but fluid food and the administration of mild purgatives, especially of the saline type, will generally free the patient from his symptoms in a very short time.

Sometimes the condition is of a more chronic type, occurring then in people of middle life, who are the subjects of persistent dyspepsia, often caused by late hours, irregular and injudicious meals, constipation and perhaps mental and nervous tension. Indulgence in alcohol adds to the trouble. These people are frequently 'livery' and look more or less sallow, but are not actually jaundiced, they lose weight, and are irritable to a degree, but none of the graver symptoms of malignant disease are to be found. The liver is probably a little enlarged and may be tender, and the gall bladder may be palpable. It is this type of patient in whom gall stones are liable to develop and for whom courses of water do so much good, as at Carlsbad or Harrogate, where hydro therapeutic measures are combined with early hours and a rigid dietary. The essential elements of the treatment can be quite well carried out at home if the patients will submit to the restrictions that must be enforced.

Infective Cholangitis is a much more serious affection, and in severe cases may lead to a fatal issue. It is usually due to the presence of a stone or stones in the common bile-duct, but may arise from other causes, e.g. ascariides or hydatid cysts which have escaped into the biliary passages from malignant disease, or it may spread backwards into

the liver from a suppurating gall bladder. The general phenomena which follow an attack of biliary colic owing to the attempted or successful passage of a gall stone are due to this cause and hence fever with or without a shivering fit a certain amount of jaundice (which is easily comprehended when one remembers the low pressure at which the bile is secreted) enlargement and tenderness of the liver are to be looked on as the characteristic features of a mild attack. *Treatment* necessarily consists in removal of the cause if possible or failing that in draining the biliary passages by cholecystostomy. It must not be forgotten that the persistent presence of such a condition may lead not only to mischief in the liver but also to chronic pancreatitis and to adhesive peritonitis which may complicate future operative procedures and therefore in any patient with well marked symptoms operation should never be long delayed.

In the more serious type of this affection suppuration extends along the biliary passages in the liver and leads to multiple abscesses a condition already noted. Drainage of the gall bladder with removal of the causative stones if present is the only hope of cure but the prognosis is very grave.

Cholecystitis or inflammation of the gall bladder is most commonly the result of the presence of stones in that cavity but may also arise as a sequela of typhoid fever. Indeed the *B. typhosus* seems to have a special predilection for this viscus and may reside there for years after the primary attack the individual as a typhoid carrier being thus a danger to the community from his ability to discharge living organisms at intervals. Streptococci or staphylococci are present in the other cases with or without the *B. coli*.

There is nothing specially noticeable about the pathological phenomena except that the viscus is intraperitoneal and that there is some analogy between the troubles arising here and in the appendix. There is however less tendency for the peritoneum to be seriously involved owing to the greater solidity and vascularity of the wall and its greater capacity for stretching thus a distended gall bladder may contain a large quantity of muco-pus without giving way and the viscus has even been opened in the pelvis or through the sac of a hernia. Protective adhesions frequently develop between the gall bladder and the stomach duodenum or transverse colon and not a few of the uncomfortable symptoms produced by gall-stones are due to their existence.

The *clinical history* varies according to whether the condition is chronic or acute. In the *chronic* variety produced by gall stones the symptoms are part of the syndrome characteristic of that condition and are but little noticeable in themselves. The gall bladder may be enlarged and a little tender on pressure should the cystic duct be blocked it will be distended with mucus or muco-pus according to the degree of irritation present. The *acute* form is evidenced by marked pain and tenderness in the right hypochondrium together with vomiting constipation and fever. The constipation may be very marked as it is due to paralysis of neighbouring coils of intestine and especially the transverse colon. The abdominal wall is held rigid and the right rectus is very tense but the enlarged gall bladder can usually be

detected beneath it. As a rule a sufficiency of adhesions forms to protect the general cavity of the peritoneum and then the abscess if unrelieved by art may burst into the bowel or may open externally and discharge itself. In the most severe forms sloughing and gangrene of the wall follow (*phlegmonous* or *gangrenous cholecystitis*) so that general peritoneal infection may ensue. In the milder forms the inflammation may in time subside the gall bladder emptying itself *per vias naturales* but adhesions of a more or less severe character are likely to be left and the gall bladder itself may shrink and atrophy.

Cholesterosis of the Gall-Bladder—In this condition the following changes take place the epithelium and stroma become infiltrated with lipoids and cholesterol and in the stroma large foamy cells



FIG. 756.—HISTOLOGICAL DRAWING OF THE WALL OF A GALL BLADDER WITH COMMENCING CHOLESTEROSIS (X 25)

of very characteristic appearance occur these cells are epithelial in origin (Figs 756 and 757). The condition is usually associated with cholecystitis and gall stones may be present it is more common in middle life and has no relation to sex or social status.

The mucous membrane of the gall bladder is congested and scattered over it are innumerable nodular specks of a bright yellow colour the whole appearance resembling that of a ripe strawberry (strawberry gall bladder).

Treatment consists in dealing with the cause if such be gall stones. In the acute variety of suppurative inflammation the gall bladder should be removed without delay just as one removes an inflamed appendix. There are frequently many newly formed omental adhesions but it is not difficult as a rule to clear the gall bladder and excise

stomach duodenum colon or pelvis of the kidney may then occur and thereby relief be given to the symptoms or they may escape into the general peritoneal cavity and cause diffuse peritonitis

The Clinical History of a case of cholelithiasis is obviously very variable according to the exact location and condition present

1 In what has been termed the *Pro Icteric Stage* when the stones are free in the gall bladder and not doing much harm the symptoms are referable rather to the stomach than to the hypochondrium The patient complains of a sense of weight and fulness in the epigastrium particularly after meals accompanied by flatulent distension which is relieved by belching or entirely removed by vomiting This may last for years and is usually accompanied by constipation Sometimes the discomfort amounts to acute pain which doubles up the patient and may be more severe on taking a deep inspiration With these

phenomena there may be a sense of chilliness scarcely amounting to a rigor and when the pain passes the patient may perspire He is often a little sallow especially on days when he feels bilious and there is some tenderness over the gall bladder but the diagnosis of gall stones is scarcely warranted unless the pain is very acute Unfortunately in this stage radiography does not often help in the diagnosis

2 When the gall-stones are loose in the bladder and attempting to escape more definite and distinct phenomena result Pain is perhaps the most marked feature and may be of various types (a) There is the localized pain due to the irritation of the gall bladder itself which is rather a dull ache referred to the right hypochondrium shooting through to the back about the level of the tenth rib and perhaps up to the right shoulder this form is usually increased on movement (b) Pain is also complained of due to the adhesions which form about the gall bladder and hamper the movements of the stomach or intestine this is often epigastric in location and may be of a colicky nature especially after meals (c) The worst pain is the typical *bilious*

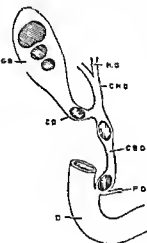


FIG 760—DIAGRAM OF GALL BLADDER AND BILE DUCTS TO INDICATE THE USUAL SITUATIONS FOR IMPACTION OF GALL STONES

GB Gall bladder HD hepat c duct CHD common hepat c duct CD cyst c duct CBD common b ile duct PD pancreatic duct D duodenum

colic due to the efforts of Nature to expel the stones This is often of an excruciating character starting suddenly continuing for a while and often ceasing as suddenly as it commenced when the stone passes on or slips back the patient may be collapsed owing to its severity It radiates from the right hypochondrium shooting over the scapular region and into the back the gall bladder may be enlarged and tense during the attack and the liver somewhat swollen Vomiting usually

occurs during or after an attack, and jaundice generally follows it, being due to the swelling of the mucous lining of the biliary passages, which prevents the escape of bile. If the stone slips back, it is not so likely to occur. The presence of many loose gall stones often determines an enlargement of the gall bladder, which can be felt from the outside.

3 *Impaction of a stone in the cystic duct* (Fig 760) is characterized by pain which is more or less persistent but with paroxysmal exacerbations, and the gall bladder becomes distended with its own mucoid secretion (*hydrops*) until it may attain a considerable size. Jaundice is usually absent. Not uncommonly acute inflammatory phenomena follow (acute suppurative cholecystitis), and this may lead to ulceration or perforation. Less frequently chronic suppuration occurs, constituting an *empyema* of the gall bladder.

4 Occasionally a stone becomes lodged at the junction of the cystic and the hepatic ducts, and then the manifestations of obstruction are very severe, and the pain may be very acute. Icterus is intense, but the gall-bladder may be empty, the liver is certain to be much enlarged.

5 The presence of gall stones in the common duct (C B D) may give rise to symptoms of the most diverse type. A small stone may originate very severe phenomena, whilst a much larger stone may cause less trouble. Frequently several stones are present and sometimes they are embedded in a mass of soft 'biliary mud,' consisting of inspissated bile salts. Their location, too, varies considerably, a single stone is perhaps found most frequently in the lower part of the duct, whilst multiple stones involve its whole length. The symptoms caused are pain of a paroxysmal character accompanied by vomiting, and jaundice, sometimes of a severe type, occasionally less marked but rarely as persistent as the jaundice due to malignant disease. The stone is more or less movable and acts as a ball valve at times allowing a certain amount of bile to pass. In malignant disease the obstruction is often absolute, and the jaundice is of a more maintained character. If the stone is located in the ampulla of Vater (Fig 760), it is easy to understand that pancreatic troubles are likely to be associated with the jaundice. In this position it may ulcerate into the duodenum without much difficulty, but should a perforation form posteriorly, the retroperitoneal cellular tissue becomes involved, and a subphrenic abscess may result.

The Treatment of gall stones is in the first place medical in character, and consists in a rigid attention to the diet, which should be simple and easily digestible, avoiding rich and fatty foods and all condiments, this is accompanied by regular exercise and the use of alkaline purgatives of a saline character and an abundance of pure water. This is best carried out at a spa such as Harrogate or Carlsbad, but can be arranged for at home if the patient will submit to the necessary regulations. Biliary colic is treated by fomentations and if need be by an injection of morphia, it is perhaps wise to administer hexamine as a biliary antiseptic, and salicylate of soda assists in increasing the fluidity of the bile. It is quite an arguable question as to what happens in such cures, whether the stones are softened and passed or whether they become acclimatized in the gall bladder and cease to cause trouble. At any rate, it is important not to waste too much time in this direction,

should the symptoms persist. It has been already pointed out that gall stones are not to be looked on as perfectly innocuous inflammatory troubles of a serious character and even malignant disease may be caused by them and therefore the persistence of symptoms and especially their aggravation indicates the necessity for surgical interference.

In cases where the stone is discovered by accident during a laparotomy for some other condition removal followed by suture of the gall bladder (*cholecystotomy*) is permissible and if the gall bladder wall is tolerably thick and healthy the abdominal incision may be closed without drainage.

When on exploration a number of stones are found in the gall bladder and no complications exist removal followed by drainage of the gall bladder (*cholecystostomy*) was formerly the custom but it has been abundantly proved to be ineffective. The mere existence of gall stones connotes a chronic inflammatory condition of its mucous lining which in this operation is still left behind and recurrence of calculous formation was only too frequent after it. At the present time surgeons are practically unanimous in insisting that complete removal of the gall bladder (*cholecystectomy*) is necessary as well as of the calculi. The operation moreover must never be completed without a thorough examination of the common bile-duct and of the hepatic ducts. This can usually be effected without much difficulty by palpation a finger of the left hand is passed within the foramen of Winslow and the common duct then lies immediately in front of it and by the practised finger even minute calculi can be detected.

In acute cholecystitis associated with impaction of the stone in the cystic duct or in the fundus of the gall bladder or in the proximal pouch like end (Hartmann's pouch) the case must be treated in a similar way to an acutely inflamed appendix viz by complete removal. Very gentle manipulation is often necessary in order to prevent rupture of the viscus and escape of infective material.

In old standing cases where the patient has had repeated mild attacks of biliary colic and definite though not very deep jaundice it is possible that a large number (perhaps hundreds) of calculi are present and experience has shown that they are to be found not only in the gall bladder but also in the common bile duct and even in the smaller hepatic ducts which may be considerably dilated. Sometimes too the bile-ducts are full of a muddy deposit difficult to remove. In such cases drainage of the biliary apparatus is absolutely essential and the employment of the gall bladder for this purpose if it be possible is generally ineffective owing to the small calibre of the cystic duct. The gall bladder therefore must be excised and either the divided stump of the cystic duct dilated and used for drainage or it may be ligatured in the usual way and the common bile duct opened and drained (Fig 761).

Impaction of a stone at the junction of the cystic and hepatic ducts is treated by cholecystectomy and division of the cystic duct close to the stone. It is usually feasible to milk the stone backwards through the opening of the divided cystic duct. If not the stump of the cystic

duct must be slit up the stone removed and the opening used for drainage purposes

A stone in the common bile-duct is removed by exposing and incising the duct (*choledochotomy*) There is but little difficulty in effecting this if the stone is in the upper part above the duodenum with a finger of the left hand in the foramen of Winslow it is localized and steadied and a longitudinal incision through the peritoneum and duct wall permits readily of its removal Careful packing with gauze swabs is necessary to protect the peritoneum from the flow of bile which is often considerable The duct is then palpated upwards towards the liver and

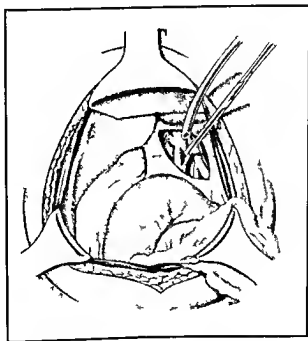


FIG 761 —DRAINAGE OF THE COMMON BILE DUCT AFTER CHOLECYSTECTOMY

down to the intestine so as to ascertain if possible the absence of other calculi and the downward passage of a probe into the intestine makes certain that the papilla is patent (Fig 762) *After drainage* —In a few cases where there has been found but a solitary stone and the history suggests its recent extrusion from the gall bladder it may be permissible to close the incision in the common duct by sutures Of course a drainage tube is carried down to the site of the incision and maintained for a few days to ensure an exit in case of leakage In the great majority of cases however the calculi in the bile duct are multiple and the symptoms of some duration and gravity the hepatic ducts are then certain to be inflamed more or less and may be considerably

dilated sometimes a good deal of grit or bile-mud is present. Under these circumstances drainage is essential and may be effected in two directions. (1) A small catheter is passed down the duct through the biliary papilla into the duodenum and retained there. This causes dilatation of the papilla and thus provides a means of escape for bile and possibly for mud or grit. It also permits the administration of abundance of fluid (saline or carbonate of soda solution with glucose) by the drip method as well as fluid meals every three or four hours. (2) Tubes are also passed upwards and for choice these should be of small size so as to enable them to be placed if thought desirable in various dilated branches of the hepatic ducts. Drainage is thereby secured and an exit provided for calculi etc. Where mud or grit is

present the tubes may advisably be of the Carrel type after the peritoneal cavity is shut off (in twenty four or thirty six hours) intermittent irrigation with saline solution may be instituted and maintained until the bile is quite clear this may take two or three weeks.

If a stone is lodged behind the second piece of the duodenum it is often possible to manipulate it upwards and deal with it above the bowel if this is impracticable the duodenum must be mobilized by dividing the peritoneum on its outer edge and then it can be displaced inwards sufficiently to enable the duct and stone to be reached.

When a stone is impacted in the ampulla of Vater and cannot be manipulated upwards the duodenum should be opened on its anterior aspect the biliary papilla sought out and a longitudinal

FIG 762.—METHOD OF PASSING PROBE DOWN THE COMMON BILE DUCT AND PALPATING THE AMPULLA OF VATER

incision made upwards from this so as to open the ampulla and allow the stone to be removed. The walls of the bile-duct and duodenum are then sutured together thereby determining the formation of a large communication between the two (*internal choledcho-duodenostomy*) which permits of effective drainage of the biliary apparatus and is a most satisfactory and beneficial procedure.

Bronchobiliary Fistula—A rare complication of acute cholecystitis is a bronchobiliary fistula. In the majority of recorded cases the most common position for the fistula was in the dome of the diaphragm over the apex of the right lobe of the liver (Fig 763). Most of the cases end fatally bile-stained sputum being expectorated while signs of pneumonia develop in the chest.

Operations on the Biliary Passages—No special preparation of the patient is required except in cases that have been long jaundiced. This condition is often associated with excessive hæmorrhage due to defective coagulability of the blood and this probably arises from a deficiency of calcium salts. It is therefore advisable to administer intravenously 5 c.c. of a 10 per cent solution of calcium chloride for three days before operation. blood transfusion may in some cases be a better procedure.

It is wise in all operations on the biliary passages to introduce a firm sand bag or triangular air cushion horizontally beneath the patient's back so as to throw the liver forwards and thereby gain better access to the deeper parts.

A right paramedian incision is that usually employed. It has however been recommended by Perthes that the incision should be made close to the middle line extending from the ensiform cartilage nearly to the umbilicus and then crossing the rectus horizontally outwards to the margin of the ribs. The fibres of the rectus muscle are secured by mattress sutures to the anterior layer of the sheath above and below before being divided so as to prevent retraction and the rectangular flap of skin and muscle is then dissected up off the posterior layer of the sheath and peritoneum which are divided by an oblique incision. The main object of this procedure which gives an admirable approach to the biliary passages is to avoid division of the nerves supplying the rectus muscle. It may be employed with advantage except in cases where drainage is likely to be necessary.

The peritoneum being opened the liver is rotated upwards and outwards and the intestines stomach and omentum are pressed downwards and inwards after protecting them by abdominal cloths. In the absence of adhesions the object of the operation can usually be attained without much difficulty but not unfrequently the presence of adhesions complicates matters considerably they must be carefully divided with a view to preventing subsequent hæmorrhage. If the gall bladder is much distended it is sometimes necessary to tap it and remove its fluid content before a decision as to diagnosis or treatment can be reached. Care must be taken not to allow the peritoneum to be soiled by the escape of bile mucus pus or stones which are almost always infected.

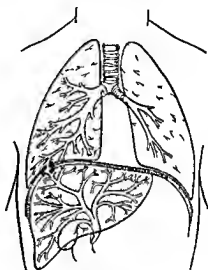
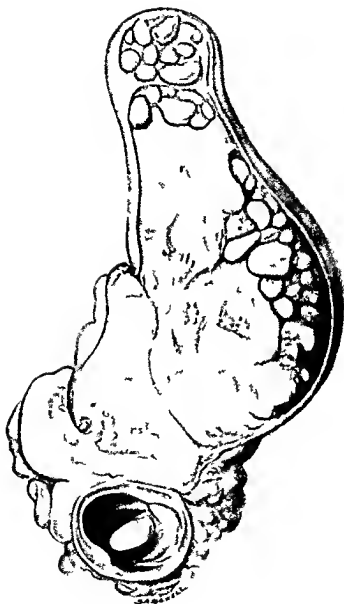


FIG. 763 — DIAGRAMMATIC DRAWING SHOWING THE SITE OF THE BRONCHO-BILIARY FISTULA.

For cholecystotomy the trocar puncture is enlarged by the knife, and the stone or stones removed by forceps, scoop, or by digital extrusion, and then the opening is closed by sutures which do not encroach on the mucous membrane. One or two rows of stitches may be employed according to the condition of the gall-bladder wall, and it may be wise to strengthen the site of union by an omental graft. For cholecystostomy a medium sized drainage-tube without lateral openings is stitched into the gall-bladder by catgut sutures, which should last about a week. The gall bladder is then fixed to the parietal peritoneum, and the remainder of the wound closed. The outer end of the tube is passed into a bottle lying by the patient's side, in which the bile collects. When the tube becomes loose, the wound is lightly packed with gauze, and for a time the patient's condition is uncomfortable, as the bile escapes into the dressings, which must be frequently changed. As, however, the wound granulates, it becomes more difficult for the bile to escape externally, and more easy for it to follow its natural course, and hence after two or three weeks the external flow usually ceases, and the wound may be allowed to close. Should the escape of bile persist, further operative treatment becomes necessary. If the presence of a certain amount of bile in the motions indicates that the common bile-duct is free from obstruction, the opening in the gall bladder may be completely closed by sutures after freeing it from adhesions. The absence of bile in the stools, however, suggests the presence of some stricture or obstruction in the bile-duct, and if this cannot be dealt with, cholecystenterostomy must be undertaken.

Cholecystectomy, as already mentioned, is the operation of choice in the majority of cases of gall stones. It is usually not a difficult procedure, and the mortality is small. The serous coat is divided on either side and over the fundus about a centimetre from its reflexion from the liver, and a line of cleavage is generally found without difficulty between the capsule of Glisson and the body of the viscus. It is then easy to separate it from the liver, the cystic vessels are secured by ligature, and finally the cystic duct is tied and divided. If possible, the peritoneal coat is drawn together over the gap left by the removal of the gall bladder, but it is often necessary to pack this space with gauze for a few days on account of oozing of blood. In many cases the surgeon is able with advantage to reverse this programme, and commences by freeing and dividing the cystic duct and by securing the cystic vessels, it is then easy to detach the gall bladder, and the loss of blood is less.

A danger that must be avoided in this operation is the possibility of dragging up the common bile-duct together with the gall bladder and removing a section of it unwittingly. The cystic duct may be very short, or adhesions may be present between the proximal end of the gall bladder and the peritoneum over the common bile-duct, it is necessary, therefore, to define very exactly the position and character of the duct before dividing it. Injury to the common bile-duct is a grave accident which must, if recognized, be dealt with without delay by suturing the ends together, or by constituting a new bile-duct,



Carcinoma of the Gall bladder with gall stones
(Museum Royal College of Surgeons)

secondary operations for this purpose are much more difficult and less satisfactory.

Cholecystenterostomy, or the formation of an artificial communication between the gall bladder and the bowel, is required in cases where jaundice persists, owing to absolute stenosis of the common duct. It has also been undertaken for the relief of jaundice due to malignant disease, either of the common bile duct, the head of the pancreas, or of the intestine, the relief given under these circumstances is, of course only temporary. The parts are exposed as described above, the gall bladder and duodenum are brought into contact, and a lateral anastomosis made by simple suturing, the technique being similar to that employed for a lateral anastomosis of the intestine.

Tumours of the Gall-Bladder and Biliary Passages are usually malignant, and of a columnar carcinomatous type, benign tumours are very rare, and merely of pathological interest. Cancer is comparatively common, and is so constantly associated with gall-stones (some authorities state that 90 to 95 per cent. of such cases also have gall-stones) as to suggest that the irritation of the latter may induce the neoplastic formation (Plate XXV). The disease is about three times as common in women as in men. Cancer of the gall bladder usually commences near the fundus and spreads upwards. The symptoms and signs are those of a hard painless swelling in the region of the gall bladder, with progressive loss of weight, and later on jaundice and ascites. Primary cancer of the common bile-duct is rarer, and may commence at the bile-duct papilla, or higher up. At first it causes jaundice, without pain and sometimes distension of the gall-bladder, the jaundice is persistent, and gradually increases in severity. Gastric symptoms from pressure on the pylorus or duodenum may follow, and extension in various directions may determine different manifestations. In either of these affections lymphatic dissemination along the falciform ligament may lead to the appearance of a secondary nodule near the umbilicus which is both of diagnostic and prognostic import.

Treatment is rarely practicable, as the disease is usually recognized too late. Excision of the gall bladder, and, if need be, of the neighbouring portion of the liver, may be practicable in a few cases, but is rarely successful. For tumours of the common bile duct excision is sometimes possible, but recurrence usually follows, cholecystenterostomy may relieve the intense jaundice and add to the patient's comfort.

Affections of the Pancreas.

The pancreas is a glandular organ secreting an active digestive juice, which escapes into the intestine through the duct of Wirsung, this traverses the whole length of the gland, and opens with the common bile duct into the ampulla of Vater, a small accessory duct of Santorini (DS) opens into the bowel about an inch higher up (Fig 764). There are two chief methods of approaching the gland (1) The transperitoneal, in which the abdomen is opened in the middle line above the umbilicus, it is reached either above the stomach by dividing the small omentum, or by traversing the great omentum just below the great

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curvature of the stomach or by opening through the transverse meso-colon (2) The retroperitoneal method consists in an incision below the last rib in the lumbar region but only the head or the tail is exposed by this procedure

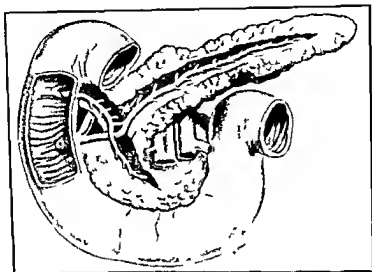


FIG 764 —DISSECTION OF THE PANCREATIC DUCTS SHOWING THE METHOD IN WHICH THEY OPEN INTO THE DUODENUM

There are various abnormal ways in which the common bile-duct and the duct of Wirsung may open into the duodenum (Fig 765)

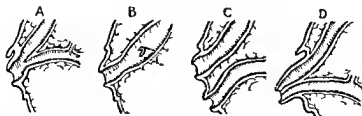


FIG 65 —THE VARIOUS WAYS IN WHICH THE COMMON BILE DUCT AND THE DUCT OF WIRSUNG OPEN INTO THE DUODENUM

A Normal B duct of Wirsung opening into common bile duct C two separate openings D two openings on a papilla

There are two chief risks associated with pancreatic lesions or operations (1) The organ is very freely supplied with blood and it is extremely difficult to ensure hæmorrhage. Ligature of the pancreatic tissue causes necrosis and from the necrotic tissue ferments are set

free which act injuriously on the tissues around and predispose to further hæmorrhage. Deep stitches and effective tamponade can alone be relied on in this direction. (ii) The leakage of pancreatic juice is a serious danger to the patient in that it is likely to determine necrosis of fat wherever it spreads; hence foci of fat necrosis may be found scattered extensively through the omentum and mesentery in all acute pancreatic lesions. Moreover it acts most prejudicially on the peritoneum and induces either an aseptic peritonitis and intestinal paralysis which may prove fatal or determines an infective peritonitis if bacteria are present.

Wounds of the Pancreas are due to direct violence applied to the epigastrium and may result from penetrating or non penetrating injuries. They are usually accompanied by lesions of other viscera such as the stomach or duodenum and surgeons should remember the necessity for examining this viscus in any traumatic condition in the neighbourhood. Deep sutures and tamponade must be used in all cases where solution of continuity has occurred the latter being needed not only as a hæmostatic agent but also in order to drain away any leakage of pancreatic fluid. A certain number of non fatal cases of injury to the pancreas are followed by fistula formation.

Pancreatic Fistula—Although the majority of cases of pancreatic fistulæ follow traumatism from without a few cases have been known to occur after accidental injury to the gland during upper abdominal operations. In some rare cases of resection of the duodenum for carcinoma or excision of a cancer of the common bile duct a fistula results. If possible the duct of Wirsung should be intubated and the catheter made to traverse the duodenum and open through the abdominal wall. After ten days or more when the catheter is removed the fistula often closes. It is surprising how much pancreatic juice is secreted each day an average being 1300 c.c. per diem. Each year cases are recorded in which a successful end result has been obtained.

Acute Pancreatitis is a grave affection involving women rather more frequently than men, often fatal and not uncommonly mistaken for a perforated gastric ulcer until diagnosed on the operating or post mortem table. It may follow an injury and is then due to an interstitial hæmorrhage which gradually increases a similar hæmorrhage sometimes appears spontaneously in alcoholic subjects and is termed a pancreatic apoplexy it is quite possible for such cases to run an acute course and even prove fatal without infection. More usually the condition is of streptococcal origin the bacteria reaching the gland from the intestine or spreading from the gall bladder by lymphatic dissemination. Regurgitation of bile even when a biliary calculus is impacted in the ampulla of Vater is usually prevented by a valvular fold of mucous membrane. Pancreatic calculi occur and may light up an attack of acute pancreatitis. The organ becomes enlarged thickened and congested purulent foci are scattered here and there in its substance and in and around it are found necrotic spots due to the action of the pancreatic secretion, and often involving the fatty tissue of the omentum and mesentery. Sometimes the whole gland or a large portion of it has been known to slough. An inflammatory

effusion develops in front which is usually virulent and sometimes hæmorrhagic, it may be limited to the lesser sac of the peritoneum, then following the lines of a subphrenic abscess, or it may involve the general peritoneal cavity.

The Symptoms vary much but usually start suddenly with acute epigastric pain which soon becomes excruciating. This is accompanied by shock, nausea, and sickness and by constipation and abdominal distension which are followed by a serious collapse that quickly threatens life. The pain is due to the swollen organ pressing on the coeliac plexus of nerves. The swelling of the abdomen commences in the epigastrium and though for a time the muscles may be rigid, they often become slack subsequently. At a later period cyanosis and dyspnœa sometimes appear and a considerable amount of fluid

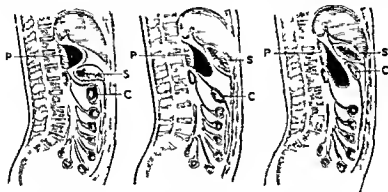


FIG. 766

FIG. 767

FIG. 768

FIGS. 66-68.—DIAGRAMS TO REPRESENT THE VARYING RELATIONS OF PANCREATIC CYSTS.

In Fig. 766 the cyst (P) projects forwards between the stomach (S) and liver into the lesser peritoneal sac presenting through the lesser omentum. In Fig. 767 the cyst is located below the stomach projecting forwards between the stomach and the transverse colon (C). In Fig. 768 the cyst lies lower between the transverse colon above and the small intestine with its mesentery.

collects in the abdomen. Occasionally the trouble subsides at the end of a few days and this may occur more than once before the final attack, which apart from surgical treatment will prove fatal.

Treatment consists in laparotomy and giving an exit to the inflammatory exudate. If diffuse peritonitis is present the abdominal cavity must be opened above and below the effusion mopped up or washed away and drainage provided. If the mischief is limited to the lesser sac it should be opened through the omentum between the stomach and transverse colon and drainage can be secured either through the anterior wound or posteriorly through the subcostal angle. The pancreas itself is usually left alone as interference with it is likely to cause hæmorrhage and escape of digestive ferments. Finally, the gall bladder is carefully explored and if there is any sign of mischief therein

a cholecystostomy may be undertaken if the patient's condition warrants it. Inasmuch as the trouble is usually of streptococcal origin serum therapy may be useful.

Chronic Pancreatitis is not to be looked on as a very uncommon lesion. It is frequently associated with gall stones and inflammation of the biliary passages and may follow gastro duodenal catarrh or ulceration. The organ may be larger and harder than usual or is shrunken and sclerosed. It may produce a swelling in the epigastrium which somewhat resembles a pancreatic carcinoma and the symptoms caused thereby are of a dyspeptic type. Fixed epigastric pain is often present and a tender spot a little above the umbilicus. Diabetes may arise in certain forms of chronic inflammation. Offensive diarrhoea with undigested fat in the stools and rapid wasting are also suggestive symptoms. Operative treatment may be of value since pancreatic or biliary calculi may be found obstructing the duct apart from this benefit has certainly been derived by cholecystostomy and drainage of the biliary passages.

Pancreatic Calculi — It may be said that pancreatic lithiasis is a rare condition for less than 150 cases have been reported in the literature and in less than ten of these a correct diagnosis was made.

There are two different types of calculi (1) True stones consisting of carbonate of lime and found in the ducts and (2) false stones

or calcification of the parenchyma resulting from pancreatitis. In the case of false stones in all probability the aetiological agent is in most cases to be found in disease of the biliary tract. True pancreatic stones are rounded and smooth and cause considerable dilatation of the pancreatic duct (Fig 769). Stones may become impacted and give rise to acute abdominal pain which radiates round the flank into the small of the back. A ray examination may reveal a stone and such an examination may be most useful but is mostly omitted. Changes in the stools are also an aid to diagnosis. The stools may be bulky, frothy and rather foul. Excess of fat is not usually present. Jaundice may or may not occur depending on the situation of the stone and the presence of pancreatitis or associated disease of the biliary tract. Diabetes is quite frequently associated with pancreatic lithiasis.

Treatment consists of exploration and removal of the stone.

Cysts of the Pancreas have been observed and treated in so many cases since 1887 that their characters are pretty clearly known. Simple complete obstruction to the duct has been proved experimentally not to be a sufficient cause for the disease some pathological condition of

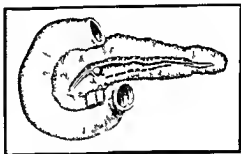


FIG 769.—CALCULUS IN THE PANCREATIC DUCT CAUSING CONSIDERABLE DILATATION OF THE DUCT

the epithelium must also be present preventing the re-absorption of the retained secretion. Slight traumatism is not an uncommon cause and a cyst may develop as a sequela of an attack of inflammation which has quieted down. The fluid within is usually turbid and brownish from admixture with blood, odourless and with a fairly high specific gravity. It is of an alkaline or neutral reaction and contains albumen but no urea or bile. It is capable of peptonizing albumen of emulsifying fat and of converting starch into sugar. The cyst can be felt as a rounded tense fluctuating or elastic swelling placed deeply in the abdomen immovable and perhaps transmitting the aortic pulsation. The relations of a cyst to the stomach and transverse colon vary (Figs 766-768) the cyst primarily forms behind the stomach, but when it attains any considerable size it projects anteriorly and then most commonly approaches the abdominal wall below the stomach and above the transverse colon (Fig 767). More rarely it presents above the stomach (Fig 766) or below the transverse colon (Fig 768). Pancreatic cysts usually develop in middle life occurring most frequently in men. Emaciation is sometimes marked since a good proportion of the fatty food passes away in the motions. The skin is often dirty, earthy and unhealthy looking.

Treatment consists in laying the cyst bare the surgeon usually finding his way to it between the stomach and transverse colon. Its contents are then drawn off by trocar and cannula and arrangements made for drainage. A large tube is inserted either through the front or from the back by the side of the vertebrae. The skin around usually becomes irritated by the discharge owing to a process of digestion. The prognosis with such treatment is good although healing may be slow and a permanent fistula may develop. Horte collected 102 cases operated on of whom 5 died 4 from the direct result of the operation 1 from infection of the fistula.

Adenoma of the Pancreas is very rare but each year as it passes seems to yield one or two reported cases. The adenoma arises in the islands of Langerhans and gives rise to attacks of hyperinsulinism. The attacks may be ushered in by a period of listlessness yawning muscular twitching and tremors peripartition and aphasia. After this the patient often becomes unconscious. The treatment consists in removal of the adenoma through a paramedian abdominal incision. A few successful cases have been reported.

Carcinoma of the Pancreas is met with either as a primary growth of a spheroidal-celled type usually scirrhous or is secondary to a similar disease of the stomach or pylorus. The condition is not necessarily painful in the early stages and may produce an ovoid or oblong mass at the junction of the epigastric and right hypochondriac regions. As it develops it becomes more painful and the patient wastes and loses appetite and energy. Jaundice gradually supervenes and becomes absolute with an enlarged gall bladder. A barium meal may reveal a very dilated duodenum due to pressure of the growth on the third part of the duodenum (Fig 770).

An anastomosis between the gall bladder and the stomach (cholecystogastrostomy) or the jejunum (cholecystojejunostomy) will relieve

the prurice with its very troublesome itching. Sampson Handley has recently reported some cases in which good results have followed the insertion of radium into the actual growth. Usually, however, the prognosis is bad; the abdomen becomes distended with fluid from pressure on the portal vein, and the legs become cedematous from involvement of the inferior vena cava. Secondary growths may develop in the liver, and the pylorus may even be pressed upon by the growth before death ensues.

Sarcoma of the pancreas is very rare and produces similar signs to those of carcinoma.



FIG. 10.—BARIUM MEAL SHINING CHRYSEID STENOPIC D. GLENN IN A CASE OF CARCINOMA OF THE HEAD OF THE PANCREAS.

Surgical Affections of the Spleen

The spleen is normally situated in the left hypochondrium, its long axis corresponding with the axis of the tenth rib. Its upper border extends as high as the upper border of the ninth rib and its lower border to the lower edge of the eleventh rib. It extends as far forward as the anterior axillary line. It is not palpable in the normal abdomen except in young children, when a just palpable spleen apart from other symptoms is not of clinical importance. It weighs about 400 gms.

Functions.—The spleen is not essential to life and its removal leads to no functional disturbance. It acts as a reserve of red blood cells and is active in contracting so that it can deliver these cells to the circulation in times of emergency (hemorrhage, anemia, hemiparesis, etc.) and the liver. The spleen plays an important part in the metabolism of red

more dangerous is the operation for its removal (other things being equal), and therefore the student should always be on the look out for minor aberrations. The size of the spleen has long been known, and ancient Greek runners whose speed was impeded by an enlarged spleen (malaria) submitted to treatment for the condition.

Surgical Affections of the Spleen.—These may be listed as follows, a more detailed description of the more important will then be given.

1 Rupture of the Spleen :

Traumatic rupture

Pathological rupture

Non traumatic rupture of normal spleen (very rare).

Rupture of a splenic aneurism

2 Wandering Spleen :

Symptomless

With symptoms

With complications

With cysts of the spleen (Fig 773).

3 Infection—Bacterial :

Typhoid

Tubercle

Syphilis

In septicæmia

In amyloid disease

Infection—Parasitic :

Malaria

Kala-azar

Hydatid

Spirochæta ictero hæmorrhagica

Egyptian splenomegaly—*bilharzia*

4 Neoplasms :

Primary sarcoma

Lympho sarcoma

Angioma

Endothelioma (Gaucher's disease)

**5 Blood Dyscrasias, and Diseases of Doubtful or Unknown
Ætiology :**

Splenic ænemia

Von Jaksch's anæmia

Myelogenous leukæmia

Lymphatic leukæmia

Pernicious anæmia

Acholic jaundice

Hodgkin's disease

Polycythæmia

Purpura

As a general statement it may be said that many of the above conditions after appropriate preliminary treatments, may ultimately require splenectomy. Obviously in other cases, *eg* rupture, preliminary treatment will not be required. In some cases operation may be avoided, *eg* malarial spleen, gummatous spleen. The indications for splenectomy may be considered under three heads

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(1) **Absolute Indications** — Where no doubt exists, the general consensus of opinion being in favour of splenectomy, successful operation is usually a cure.

(2) **Relative Indications** — Here much doubt may exist as to the value of the operation, which at best is only palliative, the operation may tend to check further progress of the disease.

(3) **Contra-indications** — Here splenectomy is definitely valueless, and may additionally be harmful. The diseases are now re-listed under these headings. The relative mortality is included as of course the operation may be absolutely indicated in a condition where the mortality is high, splenectomy, however being the patient's only chance.

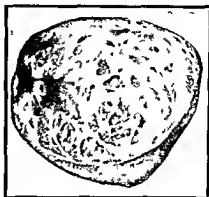


FIG 773—LARGE CYST OF SPLEEN SEEN ON SECTION

<i>Absolute Indications</i>	<i>Relative Indications</i>	<i>Contra indications</i>
(1) Ruptured spleen all forms 10 to 20 per cent	Splenic abscess	Pernicious anæmia
(2) Wandering spleen with symptoms 4 per cent with complications 40 per cent	Splenic anæmia (indi- cated in the early stages) 10 per cent	Leukæmia myeloid and lymphatic
(3) Idiopathic cysts of spleen 15 per cent	—	Amyloid disease
(4) Hydatid cyst 15 per cent	Syphilis (a very rare indication)	—
(5) Egyptian splenomegaly 12 per cent	Malaria (a very rare indication)	—
(6) Neoplasms sarcoma an- gioma endothelioma 20 per cent	—	Lymphosarcoma (use X ray therapy)
(7) Acholic jaundice 4 per cent	—	Hodgkin's disease (use X ray therapy)
(8) Thrombocytopenic pur- pura 8 per cent	—	Non thrombocyto- penic purpura
(9) Von Jaksch's anæmia	—	—

1 **Ruptured Spleen** — Rupture of the spleen may be of traumatic origin or due to disease in the spleen. The former, namely traumatic

rupture is infinitely the commoner. Spontaneous rupture of a normal spleen is exceedingly rare. When splenomegaly due to malaria, typhoid or blood dyscrasias is present spontaneous rupture due to minor injuries is not rare. Obviously this liability is much greater in the tropics.

Traumatic rupture of the spleen appears to be on the increase in this country, and after a blow in the left chest or abdomen or a run-over accident its possibility should never be overlooked. Two main clinical varieties occur.

(1) **The Classical Type**—Following the injury which usually is associated with much shock, the signs of intra peritoneal hæmorrhage occur and the patient becomes rapidly worse soon dying of hæmorrhage unless saved by laparotomy and splenectomy.

(2) **The Delayed Type**—Following the injury the patient suffers from a moderate degree of shock which typically responds to the usual measures. There is some pain in the left hypochondrium but this gradually passes off. After an interval which varies from forty-eight hours to as much as three weeks the signs of intra peritoneal hæmorrhage develop and the case like type 1 becomes of grave urgency.

It will be seen that while type 1 is the more immediately dangerous type 2 is the more insidious. In over 30 per cent of the type 2 cases the patient has been discharged back home or to work after the causative injury and before the onset of the hæmorrhage. The student should be on the watch for left subcostal pain often with referred areas to the left shoulder in these cases. As ruptured spleen is common only in young healthy adults such injuries must always be carefully treated. In about 10 per cent of cases other viscera are also damaged. A typical case can be considered under three stages.

- (1) The stage of shock.
- (2) The stage of recovery from shock but commencing hæmorrhage.
- (3) The stage of advanced hæmorrhage.

After a typical injury *e.g.* falls from a height run-over accidents blows with cricket balls the only common differential diagnoses are

- (1) Fractures of left ribs
- (2) Left-sided hæmothorax
- (3) Active collapse of left lung
- (4) Rupture of left kidney (complete rupture without hæmaturia)

Careful examination will usually serve to differentiate these conditions.

Special Signs and Symptoms—Those of shock need not be mentioned here. The features of internal hæmorrhage—rapid pulse restlessness (in marked contrast with the quiet attitude of shock) air hunger pain pallor and thirst—are classical but not indicative of the cause of the hæmorrhage. The signs which point to the spleen as the cause are upper abdominal pain tenderness and rigidity. Shoulder pain (Kehr's sign) is frequently present. The area of dullness and rigidity may spread if the condition is left the blood pouring into the left iliac fossa and later the pelvis and right iliac fossa. Ballance's sign,

viz fixed dullness in the left flank and shifting dullness in the right flank, is not to be waited for. It indicates a very advanced state.

Treatment.—In these cases treatment is urgent laparotomy and splenectomy. In all cases an assistant should arrange for a transfusion, but this should never be waited for, the surgeon's first duty being to stop the hæmorrhage. Operation should be undertaken however hopeless the case appears, as it offers the only chance of recovery. The pulse improves the moment the splenic vessels are secured. The operator should examine for evidence of injury to other organs, viz the liver, duodenal-jejunal flexure and kidney. The usual operation is splenectomy, in a few cases the spleen can be sutured, but this may be dangerous. Where splenectomy proves difficult owing to adhesions, or its size a combination of suturing and gauze plugging may be employed.

Infections of the Spleen.—Most of these need no comment, their treatment being entirely in the province of the physician. Occasionally an abscess localizes in the spleen and splenectomy may be indicated, this is more common in tropical climates. An abscess may follow enteric fever or an infected embolus or a cyst may suppurate. Fever, abdominal tenderness and leucocytosis should suggest the condition.

Splenectomy may be indicated in malarial enlargement of the spleen (after thorough anti malarial treatment has been tried). The rational treatment is the removal of a spleen which is highly liable to rupture and also the removal of a reservoir of parasites.

Neoplasms.—The spleen is a very rare site for neoplastic affections. Primary growths are uncommon and, what seems more remarkable, secondary metastases are even more rare. The spleen thus stands in these respects in sharp contradistinction to the liver. The prognosis in sarcoma of the spleen is very poor. The majority of cases die within eighteen months. Endothelioma of the spleen or Gaucher's disease, is a condition characterized by enormous enlargement of the spleen of a very chronic type. There is an associated anæmia and discoloration of the hands and face, especially of the conjunctiva.

Splenic Anæmia.—A comprehensive account of this condition will not be given here. Its main features may be summarized as a disease characterized by splenic enlargement and secondary anæmia running a progressive course. Later hepatic fibrosis (cirrhosis) sets in, and hæmorrhages from œsophageal varices are not uncommon. The disease usually starts in early adult life. Its course extends over some years, seldom more than ten, and it has a uniformly fatal ending. No medical treatment is of any real value, and radiation therapy is of doubtful utility. Splenectomy is of definite benefit in the early stages, and there is evidence that the course of the disease is long delayed, if not arrested. In the later stages, when the liver is enlarged, splenectomy is of doubtful value, and the mortality, which is low in the early case, is very high in the later one.

Purpura.—Purpura is the name given to a syndrome due to many causes, but characterized by numerous capillary hæmorrhages in the skin and mucous membranes. The condition may be latent or mani-

test. If the condition is latent and it is desired to demonstrate it the tourniquet test may be tried. A tourniquet is fastened tightly round the patient's limb and left in position from one to three minutes. Its removal is followed by a crop of petechial hæmorrhages i.e. a purpuric eruption. This constitutes a positive tourniquet test. The rash when on the limbs affects the extensor surfaces. The condition has to be differentiated from scarlet fever, measles and flea bites. The rashes which occur in septicæmia are true purpuric ones and therefore do not really enter the differential diagnosis.

Purpura is thus of surgical interest from aspects of diagnosis, prognosis and treatment.

Purpura in Diagnosis—Purpura is usually considered in two main varieties.

(1) **Primary or Idiopathic Purpura**

(a) *Hæmorrhagic Purpura*

- P simplex
- P hæmorrhagica
- P fulminans

(b) *Anaphylactoid Purpura*

- P rheumatica
- Henoch's purpura

(2) **Secondary or Symptomatic Purpura**

Infective

- Endocarditis
- Septicæmia
- Scarlet fever
- Leukæmia
- Scurvy
- Drug eruptions
- Severe jaundice

The above list is not meant to be absolutely inclusive but to indicate the main possibilities.

In **Diagnosis** purpura rheumatica (Schönlein's disease) has to be separated from acute infective arthritis. The occurrence of rashes may elucidate the diagnosis. Henoch's purpura may give symptoms suggestive of an acute intussusception and indeed an intussusception following the submucous hæmorrhages in the intestines may occur. Usually the patient is older than the common age for acute intussusception and the presence of purpuric spots on the skin will suggest Henoch's purpura.

In **Prognosis** the incidence of purpura is important. In septicæmias and the infective conditions purpura is usually of grave import. Purpura in jaundice is a warning to the surgeon to take careful steps to prevent bleeding at any operation such as laparotomy (e.g. pre-operative calcium hæmoplastin, ascorbic acid and transfusions).

Purpura from the Aspects of Treatment—Purpura calls for surgical aid in certain of its manifestations. All the primary purpura in their

acute states are benefited by transfusion. Later the condition should be investigated to consider the value of splenectomy. In cases of purpura simplex this will be unnecessary. In the other two cases if the platelet count is low splenectomy should be performed. Splenectomy must never be attempted during an acute exacerbation. It is valueless of course in the secondary purpuras.

Acholic Jaundice—This disease is of considerable surgical interest. It is frequently congenital and familial in origin though spontaneous adult cases occur. The disease consists of slight jaundice with absence of bile from the urine and a normal bile content in the faeces. The essential factor is excessive fragility of the red blood cells. These are readily destroyed by the spleen which is usually enlarged. There may be few symptoms at first though the jaundice may be obvious. A special characteristic of this condition is the tendency to form pure pigmented gall stones. These may be definite pigment stones or the whole bile may be thick with pigment particles, the condition being termed biliary mud. Acholic jaundice is one of the rare conditions where stones can form primarily in the ducts rather than in the gall bladder. That this can happen is a point of considerable practical importance when operative treatment for these stones is contemplated.

During the course of the disease crises occur which may be due to excessive blood destruction (a form of protein shock) or to biliary obstruction by stones or both.

Treatment—During a crisis the treatment is entirely symptomatic. The curative treatment during an interval is splenectomy. If this is undertaken early the results are extremely gratifying. Jaundice disappears promptly and there is great improvement in the anaemia and general well being. It should be undertaken early and if possible before stones have developed. At splenectomy the condition of the biliary passages should be investigated. At a later date cholecystectomy may be required or cholecystostomy or choledochostomy.

Von Jaksch's Anaemia—This condition essentially resembles splenic anaemia but differs from it in occurring in children three to five years old and in its improved response to splenectomy. The anaemia is very profound and the splenic tumour may be enormous. The lymphatic glands may also be enlarged. The cause of the condition

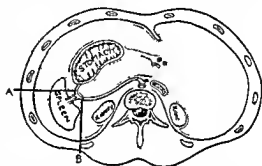


FIG. 774.—TRANSVERSE SECTION OF THE UPPER ABDOMEN TO SHOW THE VASCULAR AND PERITONEAL RELATIONS OF THE SPLEEN.

A B are the two pedicles requiring ligation in splenectomy. A the gastro-splenic omentum with the vasa brevia. B the true pedicle containing the splenic artery.

is quite unknown. The treatment after a preliminary medical period is splenectomy.

The Technique of Splenectomy—A free abdominal incision should be made a left median left transrectus or left subcostal incision being the most frequently used. Where very wide access is required a Perthes incision where the rectus muscle is stitched to its sheath and then transversely divided at a tendinous intersection may be combined with a paramedian incision. The spleen and other abdominal viscera are examined. The spleen may be irremovable if numerous adhesions are present. To attempt removal in these cases is to invite fatal hæmorrhage. Minor adhesions are broken down and the spleen delivered. Oozing is controlled by hot packs. The spleen is then separated from the stomach by clamping and cutting the gastro-splenic omentum care is taken not to damage the vasa brevia to the stomach. The spleen is then rotated medially and the posterior peritoneal fold of the lienorenal ligament divided (Fig 774). This further mobilizes the organ.

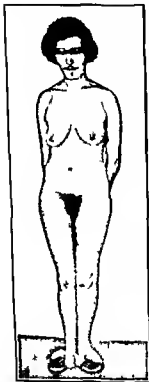


FIG 775—POST PUBERTAL VIRILISM (MR BROSTER'S CASE)

The Vascular Relations of the Spleen

The tail of the pancreas is pushed away with gauze and the main pedicle ligated securely and divided. The important post-operative complications are shock hæmorrhage local fat necrosis from pancreatic injury and pleurisy and pneumonia.

The Surgery of the Adrenal Glands

During recent years considerable research work has been accomplished dealing with the adrenal glands. In this country the names of Broster and Vines must be mentioned in this connection.

Tumours may occur either in the cortex or the medulla of the gland. Those occurring in the cortex give rise to sex precocity in children and virilism and hirsutism in the adult. Females are more commonly affected and there is a trend towards masculine characteristics.

It may be said that cortical tumours or hyperplasia give rise to endocrine disturbances of three varieties (1) hypertension (2) adrenal insufficiency if the tumour is bilateral (3) adreno-genital syndrome*.

* Adrenal Cortex by Broster and Vines (H. K. Lewis and Co.) Adreno-genital Syndrome by L. R. Broster (*Lancet* vol. 1, 1934 p. 830).

This syndrome may be defined as a condition in which secondary male sex characters appear in the female. At the same time there is a retrogression of the primary and secondary sex characters and their functions. There is an appearance of hair according to the male pattern and distribution (Fig 775). There is often a moustache and a beard or mutton chop whiskers. Enlargement of the clitoris and deepening of the voice frequently occur. The whole bodily contour approximates towards the male (Fig 776). The final picture of the syndrome will be determined by the type of lesion and the age of onset (Fig 777). The lesion whether tumour or hyperplasia is dependent on a positive reaction in the cortical cells to the Ponceau Fuchsin stain.



FIG 776 — POST PUBERTAL VIRILISM (MR BROSTER'S CASE)



FIG 777 — ADRENAL PSEUDO-HERMAPHRODITISM (MR BROSTER'S CASE)

Pre pubertal with primary
ameaorrhoea Both adrenals
greatly enlarged

A very thorough biochemical investigation is required in these cases. A routine X-ray examination of the pituitary fossa should be carried out; it is commonly small in these cases. An intravenous pyelogram should be taken to ascertain if there is any evidence of adrenal tumour causing deformation of the renal pelvis.

In the majority of cases after complete investigation it is impossible

to be sure which adrenal is the most affected. Exploratory laparotomy, is therefore carried out and the adrenals palpated, the larger one being the one to be removed. Laparotomy also has the added advantage of allowing the surgeon to inspect the uterus and ovaries of the patient, and thus detect any abnormalities. Ten days or so after the laparotomy the enlarged adrenal is removed through a high kidney route by fracturing the last rib. The operation can be conveniently carried out under gas and oxygen anæsthesia. The surgeon has to work in a confined space and bleeding may be troublesome.

Tumours of the medulla may be classified as—

(1) Neuroblastomas which are highly malignant tumours occurring in infancy.

(2) Neurocytomas which vary in their malignancy, but metastasize readily in bones and give rise to a profound anæmia.

(3) Gangliomas.

(4) Paragangliomas which are derived from the chromaffin cells. These tumours are rare and usually occur in adults giving rise to permanent or paroxysmal hypertension. They may be removed by adrenalectomy and good results are obtained.

As so often happens now that the operation of adrenalectomy has been perfected it has been used for numerous other conditions with the hope that some benefit might ensue. It may be definitely stated however that adrenalectomy is valueless in epilepsy. It may be beneficial in cases of obliterative arteritis and in Raynaud's disease, but time alone must be the judge as immediate good results may not be permanent. Bilateral adrenal denervation in two stages is being carried out in cases of hypertension, chiefly in America. In all cases of malignant tumour unless diagnosed very early, the prognosis is very bad.

CHAPTER XL

HERNIA

By the term **Hernia** is meant the protrusion of some viscus from its normal situation through an opening in the walls of the cavity within which it is contained. This may affect not only the abdominal viscera, but also the brain and lungs, giving rise to conditions which have been already described. The present chapter is limited to hernia as met with in connection with the abdomen.

The most common Situations at which hernia occurs are those spots where the parietes are weakened by the transmission of such structures as the spermatic cord and round ligament (inguinal hernia), or at the entrance of the crural canal, where the main vessels of the leg pass under Poupart's ligament (femoral hernia), or at the umbilicus (umbilical hernia). Hernial protrusions may, however, develop through the obturator foramen, sciatic notch, the diaphragm, and in various other situations.

Ætiology.—*Congenital Causes* are rather predisposing than exciting in nature, and must be looked for amongst the many malformations and conditions of imperfect development to which the abdominal parietes and contents are liable. The following are the most important:—*(a)* The non obliteration of the funicular process of peritoneum which in the male precedes and accompanies the testicle on its progress downwards from the abdominal cavity to the scrotum, and in the female passes along the round ligament. The so called congenital inguinal hernia results from this, although it must be remembered that the rupture does not necessarily show itself at birth, and, indeed, may not appear till after puberty. It is probable that most cases of acquired oblique inguinal hernia are in reality congenital in origin (Hamilton Russell). In females under the age of twenty five, hernia into the canal of Nuck, as this peritoneal tube is called, is the most frequent variety met with. *(b)* The late descent of the testis, whether it finds its way into the scrotum or not, is usually associated with the formation of an inguinal hernia of the congenital type, or of some form of interstitial hernia. *(c)* Inherited weakness of the abdominal muscles and parietes, with unusual patency of the rings, will certainly predispose to this condition, and, moreover, there is no doubt as to the tendency of hernia to run in families. *(d)* Abnormal length of the mesentery or omentum may have some influence when other conditions are present, but *per se* can have little effect. *(e)* Congenital phimosis, by inducing forcible acts of micturition, acts as an exciting cause. *(f)* Congenital apertures occur in the linea alba or linea semilunaris, especially opposite one of the tendinous intersections in the rectus, and through these one form of ventral hernia

thickened as to constitute an important element in the production of strangulation. The opening through which the hernia protrudes becomes more or less circular and so displaced that an oblique passage such as the inguinal canal becomes straight, the internal abdominal ring lying almost immediately behind the external.

Contents—Any viscus in the abdomen may be found in the sac of a hernia except perhaps the pancreas as a rule however one finds only small intestine or omentum.

An *enterocele* is the name given to a hernia containing some portion of the bowel. It is at first reducible but if the gut becomes adherent either to the sac or to some other contained structure it is rendered irreducible. It may also participate in an inflammatory condition of the sac whilst if irreducible obstruction may ensue from impaction.

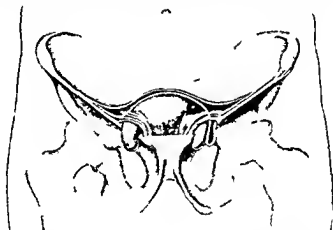


FIG. 70.—DIAGRAM SHOWING PARAPERITONEAL HERNIA OF THE BLADDER ON THE LEFT SIDE AND AN EXTRAPERITONEAL HERNIA ON THE RIGHT.

of its contents and if its vessels are constricted strangulation supervenes. For a description of these conditions see p. 131. The small intestine is much more frequently involved than the large gut. The amount of bowel protruded varies from a few inches to several feet.

If omentum is found in a hernial sac the condition is known as an *epiplocele*. As long as it remains reducible it is likely to retain its normal texture but when large in amount and especially if irreducible it becomes thickened, brawny, and matted together to such an extent as almost to constitute a solid tumour. It is often the seat of an excessive deposit of fat and in consequence of this it may become irreducible even when no adhesions are present. In some cases openings are found in it of sufficient size to allow the gut to pass through and become strangulated. When omentum and bowel are present in the same sac the condition is known as an *entero-epiplocele*.

The *Cæcum* sometimes occupies a hernial sac either in aggravated or large herniæ or in children with congenital hernia. It has even been found in a hernia on the left side. Since the cæcum has generally a complete serous covering and usually a mesentery, it is freely movable and may pass into a hernial sac in the same way as any other mobile part of the intestine.

The *Vermiform Appendix* is occasionally found in a hernial sac on the right side. It is rarely free but generally fixed by adhesions and irreducible. The hernia is more painful than usual and on palpation the appendix can sometimes be felt enlarged and tender, pressure causing pain referred to the umbilicus. The patient is likely to give a history of recurrent attacks of inflammation in the sac.

The *Bladder* may be associated with a hernial sac in the inguinal or femoral region, the former position being the more common (Fig 778).

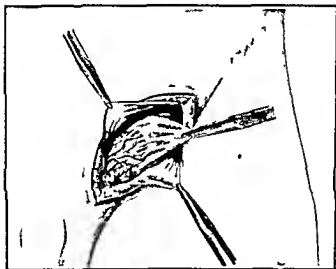


FIG. 80.—PARAPERITONEAL HERNIA OF THE BLADDER SEEN AT OPERATION ON THE INNER SIDE OF AN INGUINAL HERNIAL SAC.

Herniæ of the bladder may be divided into three varieties according to their position in the peritoneum: (1) Extraperitoneal, (2) paraperitoneal, and (3) intraperitoneal. Such herniæ may be primary or secondary; the primary are of two types, extraperitoneal or paraperitoneal, while the secondary are intraperitoneal or paraperitoneal.

In the *extraperitoneal* form the anterior or lateral extraperitoneal surface of the bladder enters the inguinal or crural canal (Fig 779). Fortunately, it is the rarest type, as in it the bladder is easily mistaken for the hernial sac and opened.

In the *paraperitoneal* variety the bladder always lies on the inner side of the hernial sac (Figs 77 and 78). The serous covering of the superior surface of the bladder forms the inner wall of the peritoneal

sac It is the most common of the three varieties and the easiest to treat successfully

The *intraperitoneal* hernia of the bladder is rare and usually secondary in origin It practically always occurs in the inguinal region There is a complete hernial sac which is external to the deep epigastric artery the upper and posterior part of the bladder enters this sac and in addition loops of small intestine and omentum are frequently found (Fig 781) Occasionally a diverticulum of the bladder may become adherent to a hernial sac and is then very liable to be laid open during an operation for the radical cure If such an accident should happen the sacculle should be excised and the opening at once closed by sutures which should not penetrate the mucous membrane Failure to recognize this accident is followed by urinary extravasation possibly intraperitoneal and will require prompt treatment if a fatal issue is to

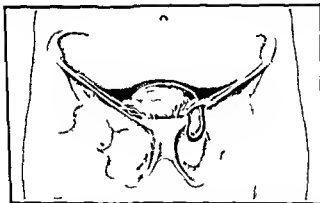


FIG 781.—INTRAPERITONEAL HERNIA OF THE BLADDER.

be avoided The wound must be reopened the gap in the bladder wall found and closed and effective drainage provided

The *Ovary* and *Fallopian Tube* are occasionally found in an inguinal hernia more often in a child than in an adult and give rise to an irreducible swelling pressure on which causes a sickening pain

Signs and Symptoms—The characteristic features whereby a hernial protrusion is recognized consist in the presence of a rounded or pyriform swelling in one of the normal or abnormal situations already mentioned which increases in size when the patient stands coughs or strains having as it is termed an impulse on coughing If intestine is present it may be possible to obtain a tympanitic note on percussion whilst the tumour is tense and rounded and on pressure slips back into the abdomen with a distinct gurgle An enterocele often gives rise to dyspeptic phenomena and perhaps to colicky pains An omental hernia feels soft and doughy has a less distinct impulse or even none on coughing and is replaced without a gurgle it is dull on percussion

The Treatment of hernia whether palliative by means of trusses or radical by means of operation differs so greatly in the various forms that it will be better to discuss each one separately

Special Forms of Hernia

Inguinal Hernia—The term *inguinal hernia* is limited to those conditions in which a protrusion occurs into the inguinal canal and if allowed to progress finally makes its way through the external abdominal ring. If it extends into the scrotum it is termed *complete* or *scrotal* whilst if it does not pass beyond the external abdominal ring it is known as a *bubonocoele* or *incomplete inguinal hernia*. The neck is always in relation with the deep epigastric artery and the structures of the cord are either spread out over the sac or are in close proximity to it. In the early stages the pubic spine can be felt to the outer side of the neck of the sac but as it increases in size it lies over the spine which can only be felt after pushing the hernia upwards and inwards.

Two main varieties of inguinal hernia are described viz the oblique and the direct

An **Oblique Inguinal Hernia** (Fig 782) is one which passes down the whole length of the inguinal canal entering at the internal and emerging at the external abdominal ring the deep epigastric artery is thus placed to the inner side of the neck. During its passage through the canal every form of oblique hernia pushes before it and becomes covered by structures representing the various layers of the abdominal parietes. Hence in cutting down on such a sac the surgeon will divide in addition to the skin and subcutaneous tissues (a) the intercolumnar fascia derived from the transverse fibres of the external oblique which pass across the external abdominal ring (b) the cremasteric muscle and fascia representing and extending from the internal oblique (c) the infundibuliform fascia derived from the fascia transversalis and (d) finally a layer of subserous tissue varying in thickness and closely surrounding the peritoneal sac. Probably the surgeon will only recognize the muscular fibres of the cremaster which serve as a useful landmark.



FIG 782—LEFT OBLIQUE INGUINAL HERNIA

There are three different forms of oblique inguinal hernia viz the acquired the congenital and the infantile or encysted

1. An **Acquired Inguinal Hernia** (Fig 783) is one in which the sac consists entirely of peritoneum protruded from within the abdomen. It gradually increases in size and finds its way along the cord to the

scrotum The sac usually extends as far as the head of the epididymis but if of large size it may overlap the testicle which lies behind it. The structures of the cord are frequently spread out over the sac. In old-standing cases the internal ring is dragged downwards and inwards and often lies directly behind the outer. Even in the earliest stages the sac is distinctly flask shaped suggesting that the condition is in reality of congenital origin.

2 *Congenital Inguinal Hernia* (Fig 784) is due to non-closure of the funicular process of peritoneum which passes down to the scrotum with the testicle and is usually obliterated completely except below where it forms the tunica vaginalis. As already mentioned the hernia does not necessarily appear in infancy its occurrence being often delayed until puberty or when the patient has to undertake heavy work. This form of hernia is much more frequently met with on the right side of the body owing to the fact that the right testicle descends into the



FIG 83—DIAGRAM OF ACQUIRED INGUINAL HERNIA SHOWING SCROTIC SAC WITH INTESTINE COMING DOWN TO THE TOP OF THE TESTIS



FIG 784—CONGENITAL INGUINAL HERNIA

A, vaginal variety B funicular type

scrotum at a later date than the left. It is always characterized by becoming complete at once and its development may be immediately followed by acute strangulation.

When the non-obliteration is complete and the patent funicular process is continuous with the tunica vaginalis the protruded viscera lie in contact with the testis; this is known as a *congenital vaginal hernia* (Fig 784 A). More frequently the funicular process is patent only as far as the head of the epididymis, being shut off from the tunica vaginalis. The hernia under such circumstances exactly resembles the acquired variety, but becomes complete at once and is termed a *congenital funicular hernia* (Fig 784 B).

In congenital hernia the structures of the cord are usually more intimately adherent to it than in the acquired form. Phimosis is often associated with this condition in young boys.

3 The *Infantile or Encysted Hernia* is one in which the funicular

process although shut off from the abdominal cavity above remains patent below communicating with the tunica vaginalis (Fig 785). The real hernial sac passes down behind the open process or invaginates it (B and C). It cannot be recognized except on operation when the surgeon is apt to open the tunica vaginalis which though reaching upwards does not communicate with the general peritoneal cavity on removing or displacing thus the true sac of the hernia is found behind it.

A Direct Inguinal Hernia (Fig 786) is one which though passing through the external abdominal ring has only travelled through a portion of the inguinal canal it is never congenital and usually smaller than the oblique type not becoming scrotal. The neck lies to the inner side of the epigastric artery (Fig 787) which is often arched very distinctly over it passing also along its upper wall. The hernia thus escapes through the lowest portion of the linea semilunaris and traverses



FIG 785—INFANTILE INGUINAL HERNIA

- A Pre hernial condition with tunica vaginalis extending upwards to inguinal canal. B Hernial sac coming down behind tunica. C sac invaginating the tunica vaginalis.

the space known as Hesselbach's triangle which is bounded internally by the outer border of the rectus muscle, by the deep epigastric artery externally, and by Poupart's ligament below (Fig 787). The obliterated hypogastric artery (II) passes across the space in a direction parallel to its outer border dividing it into two parts and according to whether the hernia protrudes through the outer or inner segment it is known as an external or internal direct hernia (2 and 3). The spermatic cord usually lies to the outer side of a direct hernia, and its constituent elements are never spread out over the sac as in the oblique form. A direct hernia is rarely found in young people and there is often a considerable amount of subperitoneal fatty tissue around the sac. The coverings are practically the same as in the oblique variety, although the cremasteric investment may be less complete.

Interstitial Hernia is the name given to an inguinal hernia which develops in some abnormal relation to the abdominal wall. Three

varieties are described (a) Where a sac exists between the transversalis fascia and the peritoneum (*intraparietal* form or *properitoneal* hernia) either with or without a hernia in the usual position. This abnormal pocket of the sac is found either between the symphysis pubis and the bladder (*hernia inguinalis ante-vesicalis*) or it extends outwards towards the iliac fossa (*hernia inguinalis intra iliaci*). As no external swelling is caused by this condition it is usually impossible to recognize its existence prior to operation occasionally it is the cause of a continuation of the symptoms of strangulation when apparently successful taxis has been performed owing to the strangled bowel having been pushed backwards from the superficial into the deeper portion of the sac. (b) An abnormal sac forms between the internal and external oblique muscles (*interparietal* form) producing a swelling in the inguinal canal covered by the external oblique aponeurosis and gradually spreading upwards and outwards parallel with Poupart's ligament.

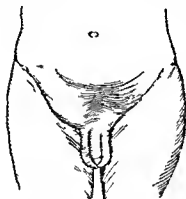


FIG 746.—DIRECT INGUINAL HERNIA

It may be associated with late descent of the testis the external abdominal ring being closed so that the organ and with it a hernia can only travel forwards and outwards beneath the external oblique aponeurosis. Sometimes the condition is due to the existence in the sac of an ordinary oblique hernia of a more or less complete septum at the level of the external abdominal ring formed either by adhesions or by a mass of adherent omentum. The sac is then shaped like an hour glass and as the usual downward course of the hernial contents is prevented the upper part of the sac yields laterally above the site of the obstruction

and passes between the muscles. (c) The hernia escapes as usual from the external abdominal ring but travels outwards along Poupart's ligament somewhat simulating a femoral hernia (*extraparietal* variety). This form is generally associated with late descent of the testis and a contracted state of the scrotum so that it is easier for the hernia to pass into the thigh and be guided by the fascia in the direction indicated.

The signs of an inguinal hernia correspond to those already described as the general clinical features of a rupture. In the early stages where merely a bubonocoele exists a fulness is noted in the inguinal canal which increases when the patient coughs. It is best detected by a finger passed through the external ring into the canal. When it becomes scrotal the swelling increases in size from above downwards and in the oblique variety is continuous with the inguinal fulness. The structures of the cord are masked by the hernia but the testicle is to be felt more or less distinctly at the lower and back part of the swelling. When

of the direct variety, the cord lies to the outer side, and although the hernia can be felt projecting from the external ring it passes directly backwards, and there is no fullness along the course of the canal.

Inguinal hernia is the most frequent type met with in the male sex the oblique variety being more common in the young, and the direct in elderly patients. In the female sex it is not rare, however, in girls and young nulliparous women, in such cases it is almost always congenital, passing into the labium along the canal of Nuck, but rarely attains any considerable size.

The Diagnosis of an inguinal hernia is a tolerably simple matter if it is uncomplicated by any other condition, it may, however, be difficult, and in old standing cases it is often impossible to distinguish the oblique variety from the direct. The conditions for which it may be mistaken are best considered in two groups.

I Whilst the hernia is still incomplete and in the bubonocoele stage, it has to be distinguished from the following

(a) *Encysted hydrocele* of the cord, which is recognized by its smooth globular outline and tense walls, the impulse on coughing is less distinct, and, although freely movable in the canal the hydrocele cannot always be entirely reduced into the abdomen, whilst the characteristic gurgle of a hernia is absent, traction on the testis, moreover, fixes the tumour, and renders it immobile. The exact limitation of the upper end of the swelling, if it can be reached, is very characteristic of a hydrocele. (b) A chronic abscess originating in the abdominal parietes, or within the abdomen or pelvis, will sometimes point through the external abdominal ring. In such cases, although there is a distinct impulse on coughing, and although the swelling is reducible, it has not the definite outline and

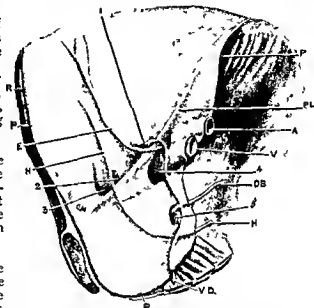


FIG 787 — ABDOMINAL WALL FROM WITHIN TO SHOW HERNIAL APERTURES

A, V External iliac artery and vein P peritoneum PL Poupart's ligament VD vas deferens E epigastric vessels R rectus abdominis H obliterated hypogastric artery OB obturator artery, 1 internal abdominal ring 2 and 3 sites of direct hernia in Hesselbach's triangle 4 crural ring for femoral hernia, 5 obturator foramen and vessels

characteristic sensation of a hernia being usually soft and fluctuant. Other evidences pointing to the existence of the original disease may also assist in determining the nature of the swelling. (c) *Enlarged glands in the groin* which have become adherent to the external oblique are sometimes mistaken for a hernia owing to the fact that on coughing a distinct impulse is communicated to them; it is however merely heaving in nature and not expansile and on digital exploration of the inguinal canal the absence of a hernia may be readily ascertained. (d) *A testicle retained in the inguinal canal* is recognized by that side of the scrotum being empty and on pressing the swelling testicular sensation may be elicited. The rounded upper end of the testis can often be detected. (e) *Tumours consisting of fat or other tissues* are occasionally seen in the inguinal canal but are characterized by the strict limitation of their upper border and usually by the absence of a distinct impulse on coughing. On the other hand as described elsewhere a mass of fat simulating a lipoma is often present resulting from a protrusion of the subperitoneal tissue a hernial sac being sometimes found embedded within it. (f) *Hamatocoele of the cord* is recognized by a

history of injury the presence of pain and ecchymosis and the absence of an impulse on coughing whilst reduction is impracticable.

2 When the hernia extends into the scrotum less difficulty is experienced in its diagnosis. By examination of the cord immediately outside the external abdominal ring all purely scrotal swellings such as hydrocele or sarcocele are readily eliminated since in them the

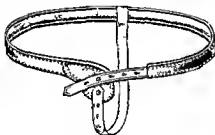


FIG 788—INGUINAL TRUSS

cord can in the early stages be felt perfectly free. A varicocele can also be similarly recognized from an omental hernia by the condition of the cord in its upper region; moreover if the patient is made to assume the recumbent posture the swelling disappears in each instance but if a finger is placed firmly over the inguinal canal so as to prevent any protrusion of omentum and he is then directed to stand up the swelling immediately reappears if it is venous in character. To the practised hand the diagnosis is never a matter of difficulty since the enlarged veins of a varicocele and omentum are not at all alike to the touch the veins moving freely under the finger like worms in a bag. When a hernia is associated with a hydrocele or sarcocele a little more care is necessary in order to distinguish between the two swellings.

The Treatment of inguinal hernia is either palliative by means of trusses or radical.

Palliative Treatment—A truss is an appliance which is designed to prevent by pressure the descent of the hernia. No one form is capable of dealing with every case and hence the truss must be selected with care so as to suit the special needs of the particular patient. A

good truss consists of a pad kept in position over the hernial aperture by a steel spring (Fig 788) which fits the patient accurately, resting behind on the middle piece of the sacrum and passing laterally midway between the crest of the ilium and the top of the great trochanter. If the hernia is unilateral the spring ends on the sound side just behind the anterior superior spine, and is prolonged anteriorly into a leather thong or cross strap which is secured to a stud on the pad. To prevent it from slipping up an under strap passes from the affected side close behind the anterior superior spine along the fold of the nates to the inner side of the thigh being fixed finally to a second stud on the pad. The pad may be rounded or oval in shape, and usually consists of soft iron protected by cork but polished vulcanite, wood, or an indiarubber cushion filled with air, water, or glycerine may be employed instead. It may be covered with leather, and the strength of the spring must be so adjusted as to retain the hernia under all conditions of strain to which it may be subjected, but without the use of undue force. In ordering a truss from an instrument-maker the only measurement required is that around the body, following the line taken by the truss, and reaching in front to the symphysis pubis,

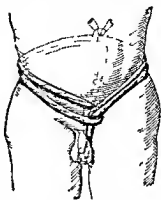


FIG 789—WOOL TRUSS FOR TREATMENT OF LEFT INGUINAL HERNIA IN AN INFANT

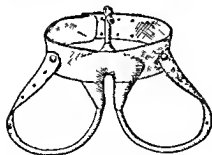


FIG 790—INDIARUBBER BAND TRUSS WITH AIR PADS FOR INFANTS

The air pads fit around the root of the penis and are inflated through the tube tied up in front. The under straps fit around the child's thighs.

two if the mother or attendants of the child conscientiously carry out the necessary details. If the hernia is once allowed to slip down, even after six or twelve months' treatment, all the previous good will have been undone.

it is also advisable to indicate the size of the hernia, and whether the opening of the abdominal parietes is large or small. In the earlier cases of oblique hernia the pad should rest rather over the inguinal canal than over the external abdominal ring, the object being to restore the valve-like action of the canal by approximating its sides. In a direct hernia the pad must be applied directly over the opening. It is very uncommon, though possible, for an acquired hernia to be cured in this way, but in the congenital hernia of children a cure may be confidently expected in a year or

In infants an efficient support is afforded by a skein of wool (specially known as *fingering*) divided at one end so that when placed round the body the cut ends of the skein can be passed through the loop forming a knot over the inguinal canal which acts as the pad of a truss. The cut ends are now passed under the perineum and tied to the transverse portion behind (Fig. 789). This apparatus is changed night and morning when the child is bathed and also if need be at shorter intervals the mother being previously instructed as to how to support the hernia whilst the apparatus is being removed. In cases of double rupture in infants an indiarubber band with two pneumatic air pads (Fig. 790) arranged so as to fit over the inguinal canals and with suitable straps and studs will often suffice and is certainly more comfortable than a spring truss. In addition to such pressure it is important to remove all causes of intra-abdominal tension as by circumcision where phimosis is present or by regulating the bowels.

The Radical Cure of inguinal hernia gives excellent results if the cases are carefully selected if the technique is satisfactory and if the after-treatment is efficient. The mortality is so small as to be negligible.

The selection of cases for an operation of this type which is not essential but only a desirable means of treatment is a matter requiring some judgment and discrimination. In an individual whose occupation does not subject him to heavy strain or exertion and who possesses a hernia which under ordinary circumstances is easily commanded by a suitably applied truss no operation is absolutely necessary although one is perfectly justified in urging him to submit to it since he will be thereby freed from the irksomeness of wearing a truss and from the possible occurrence of strangulation. If however the subject is a labouring man exposed to injury and strain and who may find it difficult to provide a suitable series of trusses the operation should always be undertaken unless distinctly contra-indicated (1) by a general inherited weakness of the abdominal muscles (2) by a relaxed and atonic condition of the abdominal parietes which is commonly associated in elderly people with slipping downwards of the mesenteric attachment of the intestine (enteroptosis) so that the hypogastrium obviously bulges or (3) by such constitutional disease as precludes all unnecessary operative interference. (4) Again in cases of very large irreducible hernia the sudden return of considerable masses of intestine which have lain for years in the hernial sac so increases the intra-abdominal tension as to disturb the heart's action and frequently to determine recurrence locally or elsewhere operative interference though very desirable owing to the great risk of strangulation incurred by the patient is often followed by very bad results unless the patient has previously been put through a course of semi-starvation and persistent taxis in order to reduce gradually the size of the protrusion.

As to the best age at which to operate statistics definitely prove that it is essentially an operation of adolescence the results gradually getting worse as the age increases. Young children can often be cured by careful truss pressure but if after a year's trial this is ineffective operation should be undertaken and is usually both simple and satisfactory.

The operation for the radical cure of an inguinal hernia has been gradually evolved and is based on the recognition of two general principles, *viz* (1) It is essential to remove the sac completely, or otherwise so to deal with it as to make it harmless and (ii) the defect in the abdominal wall must be closed in such a manner as to leave sufficient room for the due protection of the spermatic cord. In young people the sac is the important element, and the muscular defect of less importance, as age progresses, the lesion in the wall requires more careful attention, until in old people with small direct hernias the sac may often be neglected, and attention given solely to the abdominal parietes. It must also be noted that in young people the upper part of the canal is the chief area of weakness but in elderly people this shifts to the lower part of the canal.

Many different operations have been described, and in efficient hands they are all capable of giving good results. It must here suffice to describe carefully one typical operation, *eg* Bassini's, and then to note some of the modifications which have been suggested.

Bassini's operation may be described in the following stages (1) The pubic region having been previously shaved and thoroughly purified, an incision is made in the direction of the inguinal canal and cord, about $2\frac{1}{2}$ inches in length, its centre being a little above the external abdominal ring. This is deepened until the cord is reached, the superficial external pudic artery being necessarily divided *en route*, the pillars of the ring are clearly defined, and the external oblique aponeurosis is slit up in the direction of the cord. (2) The sac has now to be identified, if the hernia is one of old standing, or contains adherent omentum or intestine, it is easily recognized, but if it is thin, empty, and of recent formation, and especially in the case of a bubonocoele, its identification may be a matter of some difficulty. The cremaster and other coverings of the cord are incised longitudinally, and the sac looked for and isolated with as little handling and disturbance of the parts as possible. Enlarged veins may be removed, as also fatty protrusions from the subperitoneal tissue. It is sometimes necessary to lift up the structures of the cord in order to define the sac, which is often recognized by the white convex border of the fundus. (3) If the sac is empty, it is freed from its connection with the structures of the cord without opening it, and isolated as far as or beyond the internal abdominal ring, as indicated by a collar of fatty subperitoneal tissue surrounding the neck. If the hernia is irreducible, the sac is laid open, its contents freed from adhesions, and the intestine returned into the abdomen, whilst omental tissue is removed and the stump replaced. Adhesions are carefully divided either by the finger or between ligatures, if the gut is closely adherent to the sac, it may be necessary to leave a small portion of this attached to the intestine, which is then returned. Omentum, whether adherent or not, should be removed, as the elongated fringes are very liable to contract adhesions to the abdominal parietes which subsequently produce mischief. In removing omentum, it is not advisable to encircle a large mass with a single ligature, as it is then more difficult to replace, the vessels are less securely commanded, and a pocket or pucker may

be produced possibly leading to internal strangulation at a later date. Small portions including one or more of the larger vessels should be taken up one after another and tied separately and with advantage at different levels so as to assist in the subsequent return of the stump. The protruded mass is then cut away below the ligatures and the stump replaced after seeing that no bleeding point remains unsecured. The sac being now emptied is isolated as far as the internal ring. (4) The neck drawn firmly down is transfixed as high as possible and ligatured with sterilized catgut so that when the sac is cut away below the ligature the stump retracts well above the internal ring and presents a flush surface towards the intestines. (5) The opening in the ab-

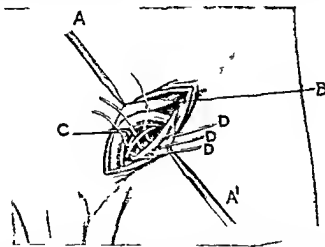


FIG. 91.—BASSINI'S OPERATION FOR RADICAL CURE OF HERNIA

- A A' Spencer Wells forceps holding aside the divided portions of external oblique aponeurosis. B arched fibres of internal oblique continuous on the inner side with the conjoint tendon. C hook or retractor holding aside the spermatic cord. D D D deep stitches passed behind the cord through the deepest fibres of Poupart's ligament on the outer side and through the conjoint tendon on the inner.

dominal parietes is closed by a row of sutures passing through the arched fibres of the internal oblique and transversalis muscles or through the conjoint tendon on the inner side and through Poupart's ligament on the outer, the stitches being all placed *behind* the cord. To effect this the cord is drawn up out of the wound and held aside by a retractor (Fig. 91) whilst the divided margins of the external oblique aponeurosis are grasped by pressure forceps (A, A'). Gentle traction on the lower pair enables the deepest portion of Poupart's ligament to be defined and seen. The stitches must secure a good hold of the tissues but should not include the external oblique aponeurosis and when dealing with Poupart's ligament the proximity of the iliac vessels must not be

forgotten. Either interrupted or looped mattress sutures may be used, but if the latter, they must not be tied too tightly, as they may strangle the portions of tissue included in their grasp and cause necrosis. The opening in the abdominal parietes is in this way commanded as far down as the pubic spine, but sufficient room must be left at the upper end for the passage of the cord. Sometimes it is desirable to introduce a stitch above the cord in order to command a spot where recurrence is not uncommon. When the three or four needful stitches have been introduced and tightened the cord is replaced, and the divided portions of the external oblique are sutured together over it, as also the deep fascia. (6) The wound in the skin is closed by a continuous suture, and usually no drainage-tube is needed.

After Treatment.—The patient is placed in bed with the knees slightly flexed over a pillow. The wound, as a rule, does not require dressing for eight or ten days when, on removal of the stitches, it should be found completely healed, if asepsis has been maintained. The patient should turn to the opposite side in order to pass water, and the greatest care must be taken to prevent the dressing becoming soiled. Occasionally retention of urine follows this operation, necessitating the use of a catheter. In the case of children, it is well to employ the open method of treatment suggested.

The length of the stay in bed and of the subsequent convalescence varies with the age of the patient and the character of the operation. In the case of children, where no hard work is undertaken, the stay in bed need not last more than ten days or a fortnight, and they may be allowed to return to ordinary life as soon as they are fit. Young adults should be kept in bed for two weeks, given two or three weeks for convalescence, and may then return to light work, heavy strain should be avoided for three months. Older people, especially in cases of direct hernia, should stay in bed for three weeks, another three weeks should be spent in convalescing, and no hard work be undertaken for six months. Trusses are not needed after an efficient operation, and indeed do harm by causing pressure-atrophy of the scar tissue. Where, however, there is doubt as to the efficiency of the cure, and especially if stitches have given way owing to suppuration, or if the abdominal walls are badly developed, or in elderly people, a light truss may sometimes be worn with advantage. Of course, special peculiarities of particular cases necessitate modifications of these general suggestions.

The treatment of *congenital hernia* differs in no particular from that already described, except that the sac must be divided below as well as above, and the lower opening secured by suture or ligature, so as to close the cavity of the tunica vaginalis. The operation often proves difficult owing to the intimate adhesions between the sac and the structures of the cord, and it is sometimes wiser merely to open up the canal and secure the neck of the sac high up where it is more readily isolated.

In *inguinal hernia* no operation should be performed which does not expose the whole of the inguinal canal, so that the hernial sac can be transfixed at the internal abdominal ring.

and thus provide an effective floor to the canal and a satisfactory barrier against a hernial protrusion. In other cases it may suffice to employ sutures of living fascia (Fig 793) as advised by Gallie in order to build up a reliable barrier against further protrusion.

Recurrence after Operation is much less common than formerly and statistics go to prove that in experienced hands less than 10 per cent of the cases recur and that rarely after the first twelve months. It is often due to a want of appreciation of the necessity for isolating the sac as far as possible since otherwise the infundibuliform opening at the top of the closed peritoneal canal is certain to persist. Another cause of recurrence is pyogenic contamination of the wound if the deep stitches are not involved no great harm is done but whenever they have been removed or come away recurrence is probable. Relapses are also due to splitting or tearing of the tendinous structures around either by the mere passage of the needle or by the traction induced by tightening the sutures indeed it is usually the case that a hernia originally oblique is after operation followed by one that is direct and probably from this cause.

Whenever it appears likely that recurrence may occur a light truss should be ordered. If however a hernia has developed a second operation may be performed if warranted by the condition of the abdominal parietes.

Femoral Hernia—A femoral hernia is one which travelling down the crural canal presents at the inner and upper part of the thigh through the saphenous opening. It occurs most commonly in women on account of the greater expansion of the iliac crests allowing increased space beneath Poupart's ligament and especially in those who have borne children. During parturition the inguinal regions are in a measure protected and hence inguinal hernia is rarely caused in this way. In young people however it is more common in the male sex.

The crural canal constitutes the inner compartment of the femoral sheath a space usually occupied by fatty cellular tissue lymphatic vessels and perhaps a lymphatic gland. It is about $\frac{3}{4}$ inch in length anteriorly and $1\frac{1}{2}$ inches along its posterior wall it is closed above by a thickened portion of the subserous cellular tissue known as the septum crural and its lower end is formed by the saphenous opening and closed by the cribriform fascia. Hence a femoral hernia as it passes downwards receives the following coverings (a) peritoneum (b) subserous cellular tissue including the septum crurale a layer sometimes known as the fascia propria and occasionally represented by a thick fatty envelope (c) the anterior layer of the femoral sheath derived from the fascia transversalis (d) cribriform fascia (e) subcutaneous tissue and (f) skin. In its passage through the canal it is situated immediately internal to the femoral vein and pressure upon this may produce oedema of the leg whilst Gimbernat's ligament lies to the inner side. The spermatic cord or round ligament is placed just above and internal to it but on a superficial plane whilst the epigastric artery is not very far from the outer side of the neck. Occasionally the obturator artery arises from this latter vessel (once in three and a half subjects) it may pass to the inner side of the neck of the sac along the border of Gim

bernat's ligament (once in seventy five times) but more commonly runs between the neck and the femoral vein. When once it has emerged from the saphenous opening a femoral hernia usually travels upwards and outwards along Poupart's ligament towards the anterior superior iliac spine being guided by the attachment of the deep layer of the superficial fascia when of large size it may extend considerably above the level of Poupart's ligament. Femoral herniæ are less likely to contain omentum than the inguinal variety a portion of the ileum is most often present but occasionally the ovary or Fallopian tube may be found in the sac.

The Signs of a femoral hernia are very characteristic. A rounded swelling with an impulse on coughing and more or less reducible forms on the inner side of the thigh its neck or aperture of communication with the abdomen lying to the inner side of the femoral vessels and to the outer side of the pubic spine.

which can always be easily felt (Fig 794). There is usually but little difficulty in making a diagnosis although occasionally some care is needed. (a) An *inguinal hernia* is recognized by the fact that its neck occupies the inguinal canal the saphenous opening being free whilst it is also above and internal to the pubic spine and above Poupart's ligament at its point of exit it tends to pass downwards into the scrotum or in females into the labium. Femoral hernia on the other hand usually (but not invariably) occurs in women over twenty five years of age the inguinal canal is free whilst the neck is in the situation of the crural canal below and



FIG 794.—B LATERAL FEMORAL HERNIA

external to the pubic spine and below Poupart's ligament moreover, it travels upwards and outwards the labium being unaffected. (b) An *enlarged lymphatic gland* over the saphenous opening may simulate this condition very closely but the absence of impulse on coughing and of the usual hernial signs is generally sufficient to distinguish it when however the hernia is purely omental and irreducible the impulse is so slightly marked that correct diagnosis in a stout woman is often difficult without an exploratory incision. (c) A small *lipoma* in the canal somewhat resembles a hernia but the limitation of the tumour its greater mobility and the absence of an impulse on coughing should suffice to prevent a mistake. (d) A *psaos abscess* pointing at the saphenous opening resembles a hernia in the existence of a reducible swelling with an expansile impulse on coughing. It is distinguished from it by the fact that there is no gurgle on reduction that the abscess as it passes under Poupart's ligament lies to the outer side of and

behind the vessels and that a tense swelling occupies the iliac fossa between which and the swelling presenting at the saphenous opening fluctuation can be readily detected the characteristic signs of spinal caries are also usually present (c) In *varix of the internal saphena* a pouch or ampulla developing close to its upper end may be mistaken for a femoral hernia on account of the marked impulse on coughing and because the swelling disappears on assuming the recumbent position The impulse however is of a different character to that of a hernia the blood can be felt to be driven past the examining finger with a thrill instead of there being merely an expansile bulge Moreover if the swelling is reduced by recumbency and a finger is then placed over the upper end of the crural canal so as to occlude it the dilated vein fills up again from below on assuming the erect position

the hernia does not descend Finally other signs of varix are usually present in the limb

Treatment—When reducible and of small size a femoral hernia may be treated by the use of a truss similar in nature to that used for an inguinal hernia except that the pad extends somewhat lower so as to maintain pressure along the course of the canal It is not however a desirable practice

Operative Treatment, with a view to radical cure is always desirable when practicable and ought to form part of all operations for the relief of strangulation The complete removal of the sac is an essential part

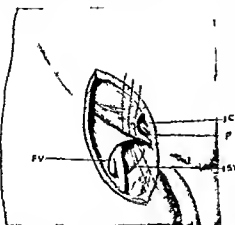


FIG. 95.—DIAGRAM OF THE RADICAL CURE FOR FEMORAL HERNIA

P Poupart's ligament IC, inguinal canal
FV femoral vein ISV internal saphenous vein

of the procedure and the blocking of the entrance to the crural canal or its obliteration by approximating its anterior and posterior walls is the only sure preventive of recurrence. Two chief methods of approach are possible one from below in the groin the other from the inguinal canal

1 In the old-fashioned operation from below the sac is exposed by a vertical incision along the course of the crural canal cleared completely of its fatty covering which is often thick and abundant emptied of its contents by reduction and then cut away after transfixing and tying the neck. Some surgeons however retain the sac pushing it back into the abdomen and using it as a pad across the upper opening of the canal. The fatty covering of the sac must be dealt with in a similar way The deep ring is then commanded by one of

the following methods (1) In many of the simpler cases it will suffice to introduce three sutures through the inner end of Poupart's ligament (Fig 795) and deeply through the horizontal fibres of Cooper's ligament which lie in close apposition to the horizontal ramus of the pubis. There are but few cases where this manoeuvre if effectively carried out, is not sufficient to determine closure of the canal but for this purpose the hernia needle must be carried down to the bone, and not merely through the fascia over the pectineus. (2) In a few cases perhaps where the opening is larger, it may be desirable to approximate Poupart's ligament to the horizontal ramus by some other method and for this purpose Roux has advised the use of a \cap shaped metal staple which traverses the ligament and the free ends of which are driven into the bone. This plan appears to us undesirable since the

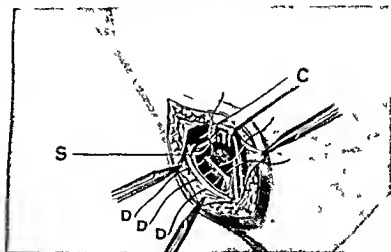


FIG 796 —LOTHEISEN'S OPERATION

C Retractor D sutures passing between Cooper's ligament and Poupart's ligament S neck of sac transfixed

staple occasionally works loose and then the proximity of the femoral vein makes it an unwelcome neighbour. (3) A good substitute for this plan has been practised by Nicoll of Glasgow who drills the horizontal ramus from below upwards in two spots and passes a mattress suture through Poupart's ligament, and the free ends through these drill holes tying them below, the ligament is thus safely approximated to the inner and upper aspect of the pubis.

The general results of this operation have proved very unsatisfactory in the hands of most surgeons a large percentage of cases recurring (20 to 30 per cent). This is probably due to three causes *viz* ligaturing the sac below the crural canal without sufficient traction insufficient clearance of the neck of the sac some of the fatty envelope which descends with the sac remaining and preventing

perfect occlusion of the canal and inefficient closure of the canal

2 To obviate these defects an *Inguinal Operation* (Lotheisen's operation) has been practised of recent years so as to deal more effectively with the neck of the sac and to avoid the dangers associated with the close proximity of the femoral vein. An incision is made as for inguinal hernia but is carried a little further inwards over the pubes. The inguinal canal is opened up by incising the external abdominal ring and carrying the incision up and out. The internal oblique and transversalis together with the cord or the round ligament are drawn aside by one retractor whilst the external oblique is retracted outwards by another. The floor of the canal can now be seen and is carefully explored so as to lay bare the subperitoneal fat covering the neck of the sac which is defined. If the hernial contents are reducible the sac can often be



FIG. 97.—A CASE OF EXOMPHALOS

pulled up without trouble into the wound and there ligatured and excised but if there is difficulty with this the sac must be exposed below Poupart's ligament by pulling down the lower flap of skin. It can then be cleared of its fatty envelope opened and its contents dealt with by open reduction or removal so as to enable the sac to be pushed up through the crural canal into the upper part of the wound. There its neck is cleared transfixed and ligatured and the fundus cut away. The femoral ring is now clearly visible and can be controlled by sutures passed between Cooper's ligament behind and Poupart's ligament in front under the guidance of the eye and it is this together with the complete removal of the sac that constitutes the special merit of this procedure. There is no groping in the dark but the surgeon can see what he is doing.

(Fig. 96) In cases of difficulty where considerable tension is likely to fall upon the stitches it may be desirable to detach a flap of the anterior sheath of the rectus muscle and secure it across the upper opening of the crural canal by stitching it to the under side of Poupart's ligament as far out as the femoral vessels. Careful closure of the inguinal canal completes the operation which has been followed by good results.

Umbilical Hernia.—Three different forms of umbilical hernia are described.

1 **Congenital Umbilical Hernia or Exomphalos** is an exceedingly rare condition due to imperfect closure of the abdominal walls as a result of which part of the intestine is found at birth in a cavity at the base of the umbilical cord which is bulbous and enlarged (Fig. 797). If the condition is overlooked it may be included in the ligature with which the cord is tied and fatal strangulation or at the best a faecal

fistula will result. If left untreated until the cord has separated the peritoneal cavity will be laid open and septic peritonitis ensue. The question of *Treatment* depends entirely on the state of development of the abdominal wall. If there is a prospect that the margins of the gap can be drawn together operation must be undertaken forthwith so as to avoid septic complications. If the abdominal wall is insufficient for the purpose nothing can be done.

2 The **Umbilical Hernia of Infants and Young People**, or as it is commonly called starting of the navel is due to weakness of the umbilical cicatrix which yields before the intra abdominal pressure. Its occurrence is often determined by chronic constipation or phimosis necessitating continual straining in order to evacuate the bowels or bladder. The condition rarely persists till adult life as it is easily cured. *Treatment* consists in regulating the bowels and in the performance of circumcision if necessary whilst the local condition is dealt with by strapping the abdominal wall in such a way as to tuck the umbilical cicatrix inwards no pad is required. In persistent cases it may be necessary to lay the sac open and remove it suturing the parts together as described in detail below. In these cases the opening is often a transverse chink rather than a round hole and it is therefore advisable to introduce the sutures in a vertical direction thereby securing transverse apposition.

3 The so called **Umbilical Hernia of Adults** is usually due to a protrusion of omentum or intestine through an opening in the linea alba either immediately above or below the umbilicus the former being the more common. A more frequent variety is that seen in women who have borne children being sometimes due to stretching or actual rupture of the linea alba and separation of the recti muscles. A peritoneal sac is present but in old standing cases it is extremely attenuated and so adherent to surrounding parts as to be unrecognizable whilst the contents may be matted together in an almost inextricable confusion. Under such circumstances obstruction is very liable to ensue and if combined as is not uncommon with a subacute form of inflammation it may even run on to strangulation. Moreover the skin over the tumour becomes stretched atrophic and not unfrequently ulcerated so that perforation may threaten. The hernia is often lobulated in outline and a considerable deposit of fat may sometimes surround it.

Treatment by retentive apparatus is of little value and certainly has no curative effect when the hernia is irreducible neither does it hinder it from increasing in size. Possibly in the early stages of a small reducible hernia a closely fitting elastic belt or bandage with a suitable pad over the opening may be of some use but the pressure required to make it effective is often a source of great discomfort.

The actual operative treatment of these cases is never easy as the patients are not favourable subjects often fat and unhealthy and possibly the subjects of chronic bronchitis. A preliminary course of treatment is always desirable so as to unload the bowel completely and to reduce the amount of fat hygienic and dietetic measures with this end in view must be instituted. The character of the operation will

vary according to whether the hernia is more or less limited to the umbilical area or whether in addition the linea alba is generally weak and relaxed. In the former a modification of the plan suggested for the infantile type of umbilical hernia may be adopted in the latter it may be well to work through a longitudinal and not a transverse

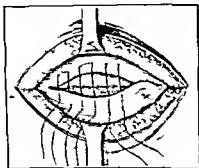


FIG 798 MAYO'S OPERATION FOR UMBILICAL HERNIA

The peritoneal layer is closed and mattress sutures have been inserted to produce horizontal overlapping of the rectus sheath

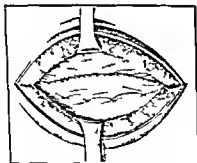


FIG 799

The mattress sutures are tied and the overlap is secured with interrupted sutures

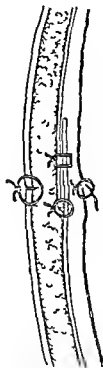


FIG 800 — A SECTION THROUGH THE ANTERIOR ABDOMINAL WALL SHOWING THE METHOD OF CLOSURE IN MAYO'S OPERATION FOR UMBILICAL HERNIA

incision so as to be able to deal with the relaxed linea alba at the same time. In both cases the same principle is adopted as that of overlapping or imbricating the edges so as to gain surface-to-surface union for the margins of the hernial opening are so unhealthy and fibrous that edge-to-edge union could never be expected.

In the so called *Mayo operation* for umbilical hernia transverse crescentic incisions are made both above and below the hernia so as to encircle it. The sac is carefully defined and cleared of fat, as also the aponeurosis of the recti muscles for some way around. The aponeurosis is then divided close to the neck by transverse incisions, and the sac opened. The contents are turned out and examined. Omentum is almost always present, and often adherent, both to intestine sac and margins of the opening. Generally speaking most of the omentum thus found is removed, it usually constitutes a thick fibro fatty mass, tangled and adherent, and useless as omentum. Special care is directed to the margins of the opening which must be completely cleared. The intestine, both small and large, is generally reduced with out difficulty when the omentum is set free. The sac, the adherent tags of omentum within it and the overlying skin are then cut away completely, and great care is taken to secure hæmostasis of the cut edges. The opening is now limited by two peritoneo aponeurotic flaps, above and below respectively, and is closed by superposing the upper of these over the lower by means of mattress sutures introduced through the margins of the lower and passed under and through the upper from within outwards as far up as one can conveniently reach (Figs 798 800). The upper flap is then stitched down over the lower, which it usually overlaps to the extent of nearly 2 inches. Kangaroo tendon may be employed for these sutures or well chromicized catgut, so that they are not too easily absorbed. The subcutaneous tissues are brought together by buried stitches, provision is made for drainage, and the skin wound is closed.

A **Ventral Hernia** is the term used in describing any protrusion occurring at some spot in the anterior abdominal wall other than those already mentioned. Several forms may be met with.

1 It consists not uncommonly of a protrusion of subserous fatty tissue through a congenital or acquired opening in the linea alba, lineæ semilunares or lineæ transversæ especially at the junction of the last with the former. They are more common above than below the umbilicus, and if, as not unfrequently happens, the fatty tissue proliferates a localized tumour resembling a lipoma is produced which goes by the name of a *fatty hernia of the linea alba*. A portion of the peritoneum is drawn through the opening into the centre of these masses, after they have persisted for some little time, and a true hernia is thus induced. Considerable pain and abdominal disturbance (vomiting, colic, etc.) accompany almost every movement of the body, being caused partly by the traction of the peritoneum partly by the constriction of the neck of the sac against the sharp edges of the small opening. *Treatment* consists in the removal of the projecting mass, care being taken not to include any viscera in the suture with which the base is surrounded. The stump is pushed back into the abdomen, and the opening closed by deep sutures.

2 After operations involving the division of the abdominal parietes, ventral hernia may be caused by the yielding of the cicatrix, especially if the wound suppurates, and the deep stitches come away or are removed, or if the opening is left patent for the purpose of draining an

intra abdominal abscess (Fig 801) *Treatment* of such cases is conducted along the lines suggested for that of an umbilical hernia viz by freeing the margins of the gap from adhesions and replacing or removing the contents the sac is then excised and perhaps the overlying fat and skin the opening is closed by overlapping the walls or by implanting a fascial graft or by deep fascial stitches (Gallie) Considerable skill and judgment are required if this procedure is to be effective but good results may be anticipated

Gallie of Toronto recommends the employment of sutures of living fascia lata cut in long strips and laced across the opening in several layers so as to constitute an effective barrier apparently it remains *in situ* and leads to a considerable fibrous development around Excellent results have followed its use



FIG 801 VENTRAL HERNIA
FOLLOWING OPERATION FOR
ACUTE APPENDICITIS

3 In women who have borne children the linea alba often stretches and yields allowing considerable separation of the recti muscles for almost their whole length and this apart from any umbilical hernia If placed in the recumbent posture and told to raise the head and shoulders from the bed without using the elbows for support the linea protrudes as a longitudinal ridge of considerable breadth Much discomfort and dyspepsia arise from this cause owing to the inefficient support given to the intestines A firm abdominal belt may be used as a palliative measure but operation is very desirable The thinned linea alba is split down the middle from top to bottom if need be on one side—say the right—it together with the neighbouring rectus muscle is separated from the subcutaneous tissues and tucked under the rectus on the left side its free end being secured by a row of mattress sutures passing through its edge and the left linea semilunaris and

being tied superficially The left free edge is subsequently secured to the right linea semilunaris by a row of stitches Redundant fat and skin are removed and the wound closed by sutures In this way the abdominal wall is drawn together like a double-breasted coat and excellent results follow

A Lumbar Hernia is a condition of considerable rarity in which the abdominal viscera protrude by the side of the erector spinæ between the latissimus dorsi and the external oblique in the space known as Petit's triangle It is perhaps seen most frequently after operations upon the kidney where suppuration has occurred and the deep stitches have had to be removed The ordinary signs of hernia are present,

and with a little care the condition is readily distinguished from a lumbar abscess. *Treatment* may be conducted along the same lines as for a ventral hernia.

A *Diaphragmatic Hernia* is usually congenital in origin arising from imperfect development of one or both halves of the diaphragm, and then generally on the left side, or it may result from traumatic lesions, such as stabs, or gunshot wounds involving the diaphragm. The omentum, transverse colon, and stomach protrude into the thorax without any peritoneal sac and give rise to various inflammatory and obstructive phenomena. It is readily recognized by a radiographic examination. *Treatment* by operation can be successfully undertaken in traumatic cases by opening the pleural cavity after excising the 9th or 10th rib, exposing the upper surface of the diaphragm and suturing the margins of the gap. In congenital cases the prospects are less promising.

Obturator Hernia consists in a protrusion of intestine through the upper part of the thyroïd foramen, and has usually been observed in elderly females. It is evidently due to the antenatal development of a peritoneal sac by the side of the obturator vessels. It is not often recognized in the living, except when strangulated, and even then it is more likely to be discovered from the abdominal aspect during a laparotomy for acute obstruction than diagnosed apart from operation. In a few cases, however, it has been noted that, in addition to the general signs of strangulation, there was a sense of deep resistance and of fulness close to the origin of the adductor muscles, and that pain was referred down the obturator nerve to the inner side of the knee. Rectal or vaginal examination may throw some light on the nature of the case. *Treatment* has generally been confined to cases of strangulation, and in these an incision is made over the inner aspect of Scarpa's triangle, and the pectineus divided or displaced. The sac when found should be opened, and strangulation relieved by cutting upwards, the obturator vessels being usually situated below the neck of the sac. If found during a laparotomy for obstruction, the same precautions must be taken as for a Richter hernia in the femoral region when discovered in the same way. It is possible to close the abdominal opening by a peritoneal purse-string suture introduced from above, if the patient is in the Trendelenburg position.

Other forms of hernia, *e.g.* pudic, pudendal, vaginal, sciatic, etc., have been described, but are so uncommon that they need no special mention.

Abnormal Conditions of Hernia.

Irreducibility of a hernia is generally due to the presence of adhesions, either between the contents and the sac, or between the contents themselves, which are thus united into a mass too large to pass through the aperture of communication with the abdomen. This is often associated with contraction of the neck of the sac, which arises either from the pressure of an ill-fitting truss or the constant drag of the contents. Overgrowth or an excessive deposit of fat in the omentum may also result in irreducibility. The local signs of this

condition are very evident dyspepsia colicky pains and a sense of dragging are among the most prominent symptoms

Treatment — In healthy individuals and if the hernia is not too large operation in these cases is desirable and indeed essential since a truss cannot be worn safely and to leave the condition unprotected is a confession of failure The operation is conducted along the usual lines of a radical cure and adhesions are dealt with suitably omentum being removed and intestines set free so as to enable complete reduction to take place A radical cure completes the procedure It has already been pointed out that it is undesirable to replace suddenly large masses of intestine or omentum that have been long outside of the abdominal cavity for fear of interfering with the heart's action and therefore in such cases preliminary rest in bed with suitable purging starvation and massage of the hernia should be adopted so as to reduce its bulk and if possible reduce its contents before operation

Failing such measures the only plan is to support the hernia in an elastic support which is tantamount to leaving it to take care of itself

An Inflamed Hernia is characterized by the existence of a localized peritonitis involving the sac and perhaps also the contents It usually arises from injury such as ill directed taxis or from injudicious truss pressure The symptoms are those of a local inflammation the part becoming hot painful tender and swollen and perhaps the skin over it congested this is associated with general fever malaise nausea and vomiting whilst constipation is generally present A condition is thus induced somewhat resembling strangulation but it is distinguished from this by the presence of fever instead of shock the absence of tension in the sac and the character of the vomiting which is not faecal The hernia is irreducible at any rate for a time probably more on account of the pain which prevents taxis than from any mechanical reason except in old-standing cases where previously formed adhesions exist Lymph is deposited on the serous surfaces and this usually leads to the formation of adhesions Occasionally where omentum is alone present an attack of this type may result in a natural cure especially in the umbilical variety

The **Treatment** consists in putting the patient to bed and restricting his diet to fluids whilst fomentations are applied to the part A little opium may also be administered to allay the pain and the lower bowel is emptied by an enema Should the condition persist in spite of treatment it will be wise to operate as otherwise strangulation may follow

Obstructed Hernia is a condition in which the onward passage of faeces through the gut contained in a hernial sac is prevented It is most frequently seen in the umbilical variety and of course only involves the large gut It is due to an accumulation of undigested food or faeces the condition being aggravated by the presence of flatus derived from the decomposition of the contents of the bowel Nausea and vomiting are induced the latter however rarely becoming feculent whilst constipation is usually present although the lower bowel may empty itself and flatus may pass Locally the tumour becomes

irreducible and distended but not tense as in strangulation, and a doughy mass, which can be moulded and indented by the fingers, is felt within the sac. There is no tenderness, but the patient complains of a good deal of intermittent colicky pain. If unrelieved, a subacute form of inflammation may supervene, and this may pass on to strangulation, and even death.

Treatment consists in the use of copious enemata, and the application of an icebag to the hernia, followed by carefully applied taxis so as to assist the onward passage of the impacted contents. As soon as the obstruction is overcome, a brisk purge should be administered.

Strangulated Hernia.

A hernia is said to be strangulated when the contents are constricted in such a way as to obstruct and ultimately to arrest the flow of blood in the vessels contained therein. Interference with the passage of faeces is not an essential in this condition, since omentum alone may be involved, or the intestine, if present, may only have a portion of its lumen constricted as in the form known as *Richter's hernia* (Fig. 802) whilst in *Littre's hernia* a diverticulum is similarly affected.

Two chief varieties of strangulation are described: those occurring within the abdomen, which are dealt with more fully in Chapter XLI, and those which are extra abdominal, it is only the latter to which we shall now direct attention.

External Strangulated Hernia arises in one of two ways: (a) The hernia becomes strangled immediately after its formation, this is most frequently seen in children or adolescents, the hernia being then of the congenital type, and having a long narrow sac. (b) In adults it more frequently results from extrusion of an additional amount of the abdominal contents into the sac, as the outcome of some sudden violent effort. This condition usually obtains in old standing herniæ, the neck of the sac having previously become thickened and contracted either by the pressure of a truss or the irritation of the protruded viscera. The former of these two conditions is generally acute in character, the latter more often subacute.

The site of the constriction is either at the neck of the sac or in the dense tissues external to it, but occasionally it exists elsewhere. Most frequently the active agent in the strangulation is the thickened sac wall itself, but in femoral and umbilical herniæ structures outside the sac, such as Gimbernat's ligament or the linea alba, may be the actual cause of the constriction, whilst it may also be produced by the passage of a coil of intestine under a tight adhesion or through a slit or aperture in the omentum contained in the sac. In those herniæ which become strangulated immediately after their protrusion, the constricting cause is invariably the resistance of the tissues surrounding the opening in the abdominal parietes.

Pathological Phenomena—The effects of strangulation vary somewhat with the tightness of the constriction. The circulation is seldom arrested entirely at the onset of the symptoms, but the pressure affects first, and more especially, the veins, and later, by the congestion

and exudation thus produced the flow in the arteries is brought to a standstill. Hence the constricted tissues are congested to begin with and then partly as a result of the deficient supply of arterial blood mainly in consequence of bacterial invasion gangrene ensues with or without an intervening period of inflammation.

When a *portion of intestine* is strangulated it first becomes of a dusky red chocolate or claret colour owing to vascular congestion it is thickened and stiff from exudation into its walls and distended by the formation of gas within its lumen owing to the arrest of peristalsis and the putrefaction of its contents. The surface for a time remains smooth and shiny but as the exudation into the sac increases the endothelium is shed. Occasionally some of the superficial capillaries rupture giving rise to ecchymoses and in rare instances possibly as the result of injudicious taxis the congested vessels completely empty themselves into the sac which is thus filled with clotted blood the intestine in consequence becoming lax and yellowish grey in colour. When the strangulation is relieved in this early stage the bowel soon regains its former healthy appearance. If inflammation occurs the surface becomes rough from the deposit of lymph and entirely loses its shiny and polished aspect. Gangrene results partly from the prolonged stagnation of blood and partly from the invasion of the intestinal wall by the *B. coli* and other anaerobic inhabitants of the gut which as soon as the vitality of the intestinal wall is sufficiently impaired migrate through it and by their development produce toxic bodies which still further assist the gangrenous process. As soon as it is established the intestine turns an ashy grey or lilac colour usually at one or more spots which gradually spread lose all lustre and polish and after a time become soft lacerable and offensive. Gangrene is much more common in the femoral and umbilical forms of hernia than in the inguinal (19.5 per cent in femoral against 6.1 per cent in inguinal) it is generally developed in two or three days but occasionally may supervene in less than twenty-four hours from the onset of the strangulation. It is more often seen in small herniae of recent origin than in large old standing ones. *At the point of strangulation* the gut is completely anæmic and liable to ulceration or gangrene which may subsequently result in perforation adhesions may however form between it and the neck of the sac thus preventing contamination of the general peritoneal cavity. *The intestine above the site of strangulation* becomes paralyzed and peristalsis is entirely arrested even in a Richter's hernia. Faecal material accumulating and undergoing decomposition gives rise to a catarrhal enteritis and even occasionally to stercoral ulcers which may perforate and cause general peritonitis this however is not very common in external strangulation since the small intestine is usually involved, and solid faeces are absent. In more chronic cases gangrene of the gut may be induced by the pressure of the accumulated contents and the action of the *B. coli*. The portion of the bowel *below the constriction* may be affected in a similar manner owing to the arrest of the peristalsis but to a slighter degree.

Omentum when strangled is at first congested and of a dark red or purplish colour and later on infiltrated and matted together. After

a time gangrene supervenes, and the omentum then becomes ashy grey or brown in colour, and is pultaceous and friable. It does not become offensive unless associated with intestine, since it does not contain any intrinsic source of putrefaction. If, however, it has contracted adhesions to the sac, and no gut is present, the trouble may subside, since its vitality may be maintained through the adhesions, and a natural cure of the hernia may result.

The sac is usually distended with fluid, which at the commencement is serous in character, and perhaps blood stained, this subsequently becomes turbid and mixed with lymph, and, finally, it is dark brown or yellowish-green, with a marked and most objectionable odour. Sometimes there is but little or no effusion of fluid, a condition generally due to complete strangulation of arteries and veins simultaneously and often the precursor of early gangrene. The serous lining of the sac is but slightly affected in the early stages, as, however, the case progresses, it becomes inflamed and ultimately gangrenous from the activity of bacteria, which by this time have penetrated to the turbid serum contained within it. The skin and surrounding tissues become œdematous, congested, and crepitant, and finally a natural cure may be determined by sloughing and the establishment of an abnormal anus.

The **Clinical History** of a case of strangulation is usually so characteristic that there can be but little uncertainty as to the diagnosis. The *general* symptoms are similar to those described as occurring in all cases of acute intestinal obstruction. The patient during some sudden effort notices a severe pain localized at first to one of the hernial regions, or referred to the umbilicus, this is accompanied by the usual evidences of shock: *i.e.* he feels faint, the pulse becomes slow and weak, the temperature falls, and the surface is covered by a cold, clammy sweat. This shock is often not very prolonged, and is associated with or quickly followed by vomiting, at first gastric, then bilious, and finally stercoraceous or fœcal. As this continues, the pain increases in severity, and radiates over the whole of the abdomen, which becomes tense, tender, and tympanitic. Symptoms of exhaustion supervene, caused partly by the pain and vomiting, and partly by the inability to take food, probably the absorption of toxic material from the intestines also assists in its production. Complete constipation is usually present, but the patient may pass flatus or fœces from the lower part of the intestine. The onset of gangrene is generally accompanied by a sudden fall of temperature and a cessation of pain, gradually the pulse becomes weak, rapid, and intermittent, the surface is covered by a cold sweat, the countenance becomes shrunk and drawn (the so-called *facies Hippocratica*), hiccough follows, and finally the patient dies, usually as a result of toxæmia due to the absorption of products developed either in the bowel wall or sac, or in consequence of acute generalized peritonitis.

Locally, a tumour is found in one of the usual sites of a hernia, or if already the subject of this condition, the patient may notice that his rupture has suddenly become larger. The swelling is irreducible, tense, extremely tender and painful, and without impulse on cough-

ing It is hard and rounded if bowel is involved, softer and more doughy to the touch, if omentum When gangrene ensues, the tension within the sac is reduced, pain and tenderness cease, and the skin over the tumour becomes dusky, inflamed, and cedematous, finally, evidences of gangrene show themselves externally, the parts becoming dark in appearance, and soft and emphysematous to the touch If the patient survives the necrotic tissues separate, and an abnormal anus is produced either naturally or through the intervention of the surgeon Suppuration within the sac is uncommon

Occasionally, however, cases are met with in which the above-described signs are considerably modified, and gangrene of the gut may occur without the exaggerated phenomena of a serious toxæmic type indicated above In one case the patient complained of no inconvenience beyond slight pain, although incipient gangrene was present, he walked into hospital saying that he never felt better in his life In other cases the bowel itself may give way, either along the line of

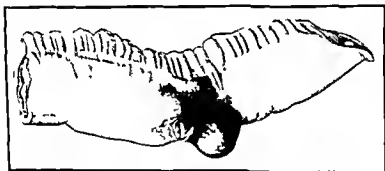


FIG 802.—INTESTINE AFTER STRANGULATION IN A RICHTER'S HERNIA. A PERFORATION HAS TAKEN PLACE (UNIVERSITY COLLEGE HOSPITAL MUSEUM)

constriction or above it, and the general peritoneal cavity may then be flooded with liquid decomposing fecal material, which quickly determines a fatal issue

The early symptoms arising from strangulation of a portion of the lumen of the intestine (*Richter's hernia*, Fig 802) are sometimes less marked than when a complete loop is constricted but the later phenomena are always very severe It is usually of the femoral variety, and the ileum is most frequently involved If less than half the circumference of the bowel is constricted, the obstruction is not always complete at first, flatus and feces being sometimes passed, but where more than half the circumference of the bowel is engaged complete obstruction from kinking or paralysis of the gut ensues The vomiting is less marked than in other cases, and is not so commonly feculent The tumour produced is small in size, but tense and tender It is quite possible, however for it to be overlooked, even when the groin is examined and the diagnosis is then likely to be made either on the operating or post mortem table The prognosis in these cases is always

grave, partly from the difficulty experienced in diagnosis, partly from the tightness of the constriction death usually results from perforative peritonitis

The occurrence of *strangulation in a pure epiplocele* is very rare the symptoms are vague in character, and the diagnosis is often difficult. The presence of a soft, doughy tender swelling in any of the hernial regions, combined with pain, bilious vomiting, and possibly constipation, is always a significant feature. So long as no kinking of the bowel is caused thereby, the symptoms may remain indefinite, the vomiting never becoming faecal, but as time goes on arrest of peristalsis may lead to true obstruction, or even general peritonitis

The mortality rate of strangulated herniae is much higher than one would expect in a condition that is easily diagnosed recent statistics show that the mortality of external strangulated hernia is 17.8 per cent

The Treatment of a strangulated hernia consists in reducing the contents by taxis, or by operation

Taxis is the term employed for the manipulation by means of which a hernia is reduced. In cases of strangulation it must be used with gentleness and great care, since the involved portion of intestine is congested and easily torn. The patient is laid on a couch with the head supported and the thighs slightly flexed, so as to relax the abdominal muscles. The fundus of the tumour is then grasped with one hand, and steady pressure made, having for its object the emptying of the congested blood vessels and consequently a diminution in the size of the hernia. the fingers of the other hand manipulate the neck of the sac, in order that the part which has most recently been protruded may be first returned. The direction in which taxis is made varies in different types. In inguinal hernia it should be directed upwards outwards and backwards. In a femoral hernia which has extended beyond the saphenous opening taxis is first employed downwards and inwards in order to make the gut re enter the crural canal, and then finally backwards and upwards, the margins of the saphenous opening being relaxed by flexing and slightly inverting the thigh. In umbilical hernia the pressure is mainly directed backwards

In the past taxis has often been used injudiciously, and in cases where it could not be expected to do any good, the bowel has sometimes been ruptured or its wall bruised, the mesentery torn and other serious results have followed. At the present day operative treatment for hernia is eminently successful, and open exploration prevents the likelihood of returning to the abdomen an infected and even gangrenous focus. *Taxis is permissible* when the hernia is of large size, particularly if inguinal, when the symptoms have a mild onset and do not become severe, and especially if taxis has been successful on former occasions. Reposition may be assisted in such cases by applying fomentations for half an hour, followed by the use of an icebag, reduction sometimes taking place spontaneously or being brought about by taxis. The heat relaxes the tissues around the neck of the sac, and the effect of the cold is not only to constrict these tissues, but also to induce contraction of the intestinal blood vessels and muscles. *Taxis is objectionable*, and

if employed at all should be used very cautiously when the hernia is small and tense and particularly if femoral when the onset is acute and sudden when the symptoms are well marked and especially if they become so in the early stages of the case if strangulation follows on the first development of the hernia and of course if the case has lasted for some time and fecal vomiting is present. A final attempt may in suitable cases be made before operation when the patient is anesthetized.

Persistence of Symptoms after Apparently Successful Taxis—It happens occasionally that although the surgeon may have apparently reduced the hernia satisfactorily the symptoms of strangulation viz pain vomiting and constipation persist. (i) Infective gangrene may involve the released coil of gut and spread to the portion above it causing death from peritonitis and toxæmia. (ii) Ulceration and perforation may occur along the constriction groove. (iii) The rupture reduced may not be the one which has given rise to the symptoms an internal hernia or one in some other region co-existing. (iv) The strangulation may have been caused not by the neck of the sac but by a slit in the omentum contained in the sac. Reduction in such a case would of course not relieve the symptoms. (v) A *volvulus* may have been present either wholly or partly in the sac and may have been reduced untwisted. (vi) The hernial sac may have a diverticulum or pocket communicating with it at its upper end (intraparietal interstitial hernia) or it may be shaped like an hour glass. It is possible to reduce the intestine from the lower portion of this so-called *hernia en bissac* into the upper pocket and then the symptoms persist. (vii) Reduction *en bloc* or *en masse* ought never to be seen as it can only occur when considerable and therefore an unjustifiable amount of force has been employed. The sac and its contents are together reduced from their superficial position to the deep aspect of the abdominal parietes and the constriction remains. The hernia in such a case disappears gradually and without the characteristic gurgle but is liable to reappear after an interval. When occurring in the inguinal region the canal appears to be unduly patent and a tense rounded swelling can be detected at its upper end.

The Operative Treatment of strangulated hernia should always be undertaken as soon as possible. Nothing can be gained by waiting whilst even the delay of an hour may make it doubtful whether the result will be successful or not. There is always sufficient time to permit of efficient purification of the parts and it is desirable to empty the lower bowel by an enema and to wash out the stomach. The administration of an anæsthetic needs care and in the worst cases local infiltration or spinal analgesia should be employed. A suitable incision is then made down to the sac which is recognized by its tense and rounded outline. It is cleared as far as possible from surrounding structures and then carefully opened. The amount of fluid varies much and is sometimes very small so that the possibility of injuring the bowel must be kept in mind. Having given exit to the fluid from the sac and noted its characters the surgeon carefully examines the bowel or omentum. The cause of strangulation is then looked for

and divided by a special hernia knife, which practically consists of a curved blunt ended bistoury the cutting blade being limited to an extent of about $\frac{1}{4}$ inch from the blunt end. If such is not to hand, an ordinary blunt ended curved bistoury will suffice. The index finger is employed to repress and guard the intestine, and acts better than a director since intestine is liable to curl up on either side of the latter, and may thus be injured. The knife is then slipped on the flat under the constriction, and turned so as to divide it, it is better to nick it slightly in two or three places than to incise it by one deep cut.

The gut is carefully drawn down into the wound, and its condition at the site of strangulation examined, it is sometimes a matter of difficulty to decide whether it should be returned or not.

1 If the gut, though congested, shows no sign of gangrene or perforation, it may be safely reduced. This is not always a matter of ease, owing to the oedematous condition of its walls which are stiff and firm. Slight enlargement of the opening will permit the gut to be returned to the abdomen. All manipulation directed to the intestine must, of course, be of the gentlest nature, since its congested state makes it more friable than usual. Omentum is removed or returned according to its condition. After the return has been effected, a radical operation for the cure of the hernia must be carried out if the condition of the patient warrants it.

2 If the gut has been more seriously damaged by the constriction and its condition is doubtful, it is well douched with warm saline solution, and the effect of this on the loop carefully noted. If, after a short time, the colour of the gut changes and becomes of a lighter hue, it is still alive and may be returned into the abdomen. Special note must be taken of the condition of the bowel along the line of constriction. In case of doubt it is returned just inside the abdomen and a large drainage tube is inserted down to it. There is no need to fix the bowel, it is already inflamed and paralyzed, and hence will not change its position, especially if a small dose of opium is subsequently administered. In this way, even if gangrene or perforation occurs, a track is left for the escape of the contents, whilst a localized plastic inflammation will shut off the general peritoneal cavity. A faecal fistula may thus be formed but it often closes spontaneously at a later date.

3 If, on the other hand, the colour of the bowel is not affected by douching, or if patches of it show up definitely as damaged or gangrenous areas in the midst of the portion where the circulation is returning to the normal, and still more so if there is any suspicion of odour caused by the *B. coli*, the death of the bowel, or of a portion of it, is assured, and treatment must consist of intestinal drainage in the first place, followed by resection of the damaged area and anastomosis.

It is never wise to attempt an immediate enterectomy and restoration of the canal by suturing. The gut above the obstruction is almost certain to be loaded with decomposing faecal material of a most irritating and dangerous character, and to allow this to pass over a newly formed suture line is too risky. Under these circumstances the constriction should be divided sufficiently to enable the healthy gut above

the line of strangulation to be drawn down and then after protecting the tissues of the wound the distended coil is tapped with a trocar and cannula. The first rush of flatus and liquid fæces is allowed to escape from the cannula and then the bowel is opened sufficiently to enable a rubber drainage-tube to be passed into and carried up beyond the line of constriction. This is stitched in and the intestinal contents are allowed to drain away for a few days. As soon as satisfactory drainage has been effected the damaged coil of gut should be resected and an anastomosis undertaken. In most cases it is desirable to open the abdomen and after protecting the exposed mucous membrane to pull the affected coil up from inside so as more safely to permit of the restoration of the continuity of the bowel after removing that portion which would be liable to develop adhesions.

In cases however where the whole loop of the strangled intestine is gangrenous and the sac infected and inflamed it may be necessary merely to divide the constriction with as little interference of the adhesions at the neck of the sac as possible and then to cut away the dead bowel and stitch in a drainage-tube so as to carry off the liquid fæces. At the end of a few days when the bowel has emptied itself the abdomen may be opened and the gut freed from inside and anastomosis performed.

The After-Treatment in cases of strangulated hernia is of the greatest importance. The patient is placed in bed and absolute quiet is maintained no food being allowed for twenty four hours. If there is no pain opium need not be administered as it helps to maintain the paralyzed condition of the bowel severe pain may however call for the hypodermic injection of a dose of morphia. Liquid food can usually be taken at the end of twenty four hours. Saline should be administered rectally by the drip method subcutaneously or intravenously this prevents thirst and replaces the chlorides that are lacking owing to the obstruction and if the patient's condition remains satisfactory it is unnecessary to administer any purgative the bowels often acting naturally if they remain unrelieved for five or six days a dose of castor oil should be given.

Post operative Complications—(1) *Vomiting* may persist for a time as a result of the anæsthetic. It loses however its fæcal character and may generally be stopped by washing out the stomach. (2) The *Paralytic* condition of the gut may cause prolonged constipation which can be treated with *B. Welchii* serum. If there is no evidence of inflammatory mischief it is best treated by a turpentine enema or later by a purgative. (3) *Acute Enteritis* may arise either in the portion of strangulated gut or just above. This is usually indicated by localized pain and the passage of mucus perhaps tinged with blood which may be so abundant as to amount to diarrhoea the vomiting moreover persists but is no longer stercoraceous. It is best treated by the administration of bismuth combined with chlorodyne whilst all solid food is interdicted. (4) It is possible that although the gut looks healthy at the time of operation its walls are in reality already infected and in spite of the relief of the constriction *infective gangrene* may follow causing death from peritonitis. (5) Occasionally acute

septic peritonitis results from a localized perforation, either of a small gangrenous patch or from ulceration along the 'constriction groove'

Treatment—The condition is obviously one of the gravest import, and must be dealt with actively, if the patient is to be saved. The abdomen must be opened, the affected coil identified, and if need be resected, or fixed in the wound and opened for drainage purposes. The peritoneal cavity itself is dealt with according to the rules already given. (6) *Localised Peritonitis* may be looked on as a conservative measure, whereby Nature isolates some focus of danger from the general peritoneal cavity. Occasionally localized suppuration follows as the result of a limited ulceration or perforation of the gut, the pus must then be let out at the earliest possible moment, but a faecal fistula is very likely to follow.

It is impossible to describe in detail every form of strangulated hernia. A few facts, however, must be stated about the more important varieties. In *Strangulated Inguinal Hernia* the constriction most commonly occurs at the neck of the sac, usually close to the external abdominal ring, as a result of the condensation of the surrounding tissues. The signs are generally very characteristic, and the condition can rarely be mistaken. Some difficulty may be experienced in distinguishing it from *inflammation of an undescended testis*, in this, however, there is no persistent vomiting or constipation whilst the absence of the testis below, and the existence of the peculiar testicular sensation when the swelling in the canal is compressed, should make the diagnosis obvious. Occasionally the two conditions co-exist, and then a correct diagnosis, apart from an open exploration, may be almost impossible. *Torsion of the spermatic cord* and subsequent strangulation of the testis give rise to a swelling not at all unlike a strangulated hernia, but should be distinguished by the history and by careful palpation.

The operation is conducted along the lines already described for the radical cure. It is always wise to open up the inguinal canal by division of the external oblique, and in not a few cases this will suffice to enable reduction to be effected, although it is desirable to open the sac and examine the bowel. If the strangulation persists, the constriction is divided by cutting directly upwards. It is often difficult in old standing cases to be certain whether the hernia is direct or oblique, and by following this rule there is less likelihood of wounding the deep epigastric artery.

In *Strangulated Femoral Hernia* it is more common to find the bowel than omentum, and it is in this situation that partial herniæ (Richter's) are most frequently seen. A tense painful swelling is felt, situated in the neighbourhood of the saphenous opening, and the diagnosis from inflamed lymphatic glands and phlebitis of a varicose saphena vein may not be altogether easy, particularly if omentum alone is present. The history of the case and a careful consideration of the physical signs and symptoms should generally be sufficient to clear up the diagnosis.

The *Treatment* of this condition may be undertaken by either of the methods described above as suitable for the radical cure. If the inferior operation is undertaken, the sac is cleared and opened, the bowel examined, and the constriction, usually at Gimbernat's ligament,

divided by cutting directly inwards. The plan already mentioned of nicking it in one or two places rather than of freely dividing it is especially desirable in this situation on account of the occasional abnormal course of the obturator artery along the edge of the ligament. Division of this artery would be recognized by the occurrence of free hæmorrhage after the use of the hernia knife and would require for its treatment opening up of the external oblique above Poupart's ligament and securing the vessel by ligature. When the constriction is very tight as in some cases of *Richter's hernia* the introduction of the hernia knife under the constriction is difficult and liable to injure the bowel.

For these and other reasons practice has of late years been tending more and more to the employment of the inguinal operation (Lothérens's) in all cases of strangulated femoral hernia. The constriction is then under the eye and the surgeon can see what he is dividing. The sac is opened from below and its contents examined; the constriction is divided from above and reduction can then be effected. The sac is freed from adhesions and displaced up through the canal and removed and a radical cure follows. If gangrene is present it is easy to carry the incision upwards and thus open the abdomen and thereby resection if necessary can be effected more readily and safely.

It is quite possible to overlook the existence of a small *Richter's hernia* and only to discover its presence during a laparotomy for an acute attack of obstruction. Under these circumstances the greatest gentleness must be exercised in any attempts to withdraw the bowel from the sac for fear of tearing the gut and flooding the peritoneal cavity with fluid fæces. It is usually well to cut down on the hernia from outside, open the sac and divide the constriction and then partly from without partly from within to reduce the strangled portion of bowel which is brought to the surface and carefully examined. In many such cases gangrene is likely to follow if not already present and drainage of the gut by a Paul's tube will be required and a subsequent enterectomy.

CHAPTER XLI

INTESTINAL OBSTRUCTION.

By Intestinal Obstruction, or *Ileus*, is meant a condition in which the onward passage of *fæces* is prevented. It is often associated with vascular phenomena due to strangulation or kinking of the gut, and these result in a deficient supply of arterial blood reaching the part, thereby predisposing to gangrene.

Various elements enter into the picture provided by a classical case of obstruction, and of these the most marked are

1 *Coprostasis*, or retention of *fæces*. The fact that simple constipation may last for a week or more at a time, and do no harm to the patient beyond a certain slight degree of toxic poisoning, demonstrates that this is not the only element in cases of obstruction, and indeed is often an almost insignificant factor in acute cases. Yet it colours the whole picture, and has very marked results in the clinical manifestations. Retention of the intestinal contents is certain to be followed by their decomposition and liquefaction, and this causes the intestinal canal to be filled with a quantity of offensive fluid material, partly due to bacterial activity, partly to the pouring out of a considerable quantity of secretion from the congested gut wall. If the obstruction is only partial, this liquefaction of the bowel contents may enable them after a time to pass on, and the patient's attack of partial obstruction is followed by one of diarrhoea whereby relief is obtained. If the obstruction, however, is complete, the intestine above the block is gradually filled with this decomposing material, from which toxins may be absorbed, the patient being thereby poisoned.

A second result of this decomposition of the retained *fæces* is the development of gas, which may be so marked as to lead to great abdominal distension, or *meteorism*. Whilst present in almost every case to a certain degree, it is most marked when there is considerable involvement of the mesentery, and experiments on animals indicate that constriction of the nerves contained therein is the chief factor in its production.

2 Increased peristalsis, with the object of forcing the intestinal contents past the block, is often an important feature in the case, leading to severe pain of a colicky character. So violent may these efforts become that the bowel, weakened by distension and inflammation, is finally torn, and perforative peritonitis rapidly ends the case.

3 Regurgitant vomiting is always a prominent element. At first the gastric contents alone are ejected, but later the vomit becomes bilious, and even stercoraceous or faecal. The origin of this phenomenon is still a little dubious. Some have considered it due to anti-peristalsis, others maintain that the ordinary onward movements of

the bowel are quite sufficient to explain it. The intestinal contents are urged forward against the face of the obstruction and being unable to pass an axial regurgitant stream is produced. It is a little difficult to see how this could occur when the lower end of the colon is the part affected. Whatever the mechanical explanation there is no question as to the influence of the nervous system in its production or as to its being chiefly reflex in character which is evident from the fact that it occurs whether omentum or bowel is strangled. Hence it is easy to understand that it commences early in children and sensitive women on account of the greater irritability of their nervous centres whilst it is also more marked when the small intestine is involved. Anything that increases peristalsis naturally intensifies its occurrence.

4 Nervous phenomena also add their peculiar features to the picture. The affected coil of bowel is directly paralyzed by the lesion but, in addition various reflex manifestations occur. Thus in acute cases the patient suffers almost at once from shock which passes off after a time and from collapse due to toxæmia at a later date vomiting and perhaps hiccough develop reflexly and the latter sign is always to be looked on with grave suspicion and as an omen of bad import. In the latest stages intestinal paralysis from the onset of peritonitis may dominate the scene.

5 Infective phenomena are likely to follow sooner or later the bowel walls being attacked by the virulent organisms contained within them. Complete paralysis and want of blood supply predispose them to bacterial invasion and hence the more acute forms of infective gangrene are chiefly seen in conditions of the strangulation type when mere obstruction is present without vascular changes. Microbic invasion rarely produces more than a patchy necrosis or more commonly perforative ulceration. Of course when infective gangrene is present virulent toxins develop in the walls of the gut and a rapid depreciation of the patient's general condition follows from their absorption.

6 Finally death is almost certain to ensue apart from surgical assistance although a few cases may recover spontaneously. The final event is due either to perforative peritonitis or to simple exhaustion the result of toxic absorption from the retained feces or from the necrotic intestinal wall or of constant pain and vomiting want of nutrition and general dehydration of the tissues.

Causes—Much elaborate work has been undertaken to produce a satisfactory classification of the many diverse causes of intestinal obstruction and when one mentions the fact that a recent attempt included eighty distinct causative lesions it is obvious that there is an abundant field for this type of ingenuity. It must suffice here to state that there are two great divisions—the dynamic and the mechanical.

(1) Dynamic ileus is due to some paralytic or spasmodic condition of the intestinal wall which causes interference with its power of transmitting onwards its contents. Paralysis of the bowel results from (a) Diffuse or localized acute infective inflammation as in septic

peritonitis or acute appendicitis (b) torsion of intra abdominal viscera, such as the spleen or omentum, or of tumours, *e.g.* ovarian cysts, leading to the so called aseptic peritonitis (c) embolus or thrombosis of the mesenteric vessels, leading to necrosis (d) nervous lesions, which may involve the spinal cord itself, or more frequently the peripheral nerves, *e.g.* a tumour at the root of the mesentery Spasm of the gut, as by chronic lead-poisoning, may also determine obstructive phenomena

(2) Mechanical ileus is the variety most commonly seen (a) The gut may be *strangled* by bands or through apertures, causing internal strangulation (b) It may be *kinked* over bands thereby determining not only occlusion of the lumen, but also a marked interference with the vascular supply (c) The intestine may be *twisted* on its own axis giving rise to a condition known as volvulus (d) One portion of the bowel may be *invaginated* into a neighbouring portion constituting an intussusception (e) The lumen of the bowel may be *blocked* by foreign bodies or accumulations of faeces (obturation) (f) The onward passage of the faeces may be rendered difficult or impossible by the gut becoming *narrowed* as from cicatricial or cancerous stenosis, or by the pressure of external tumours

The most useful division is, however, the clinical grouping together of cases which present a similarity of symptoms, and this method will be employed here, the subject being discussed under the three headings — Acute Obstruction, Chronic Obstruction and Intussusception

Acute Intestinal Obstruction

The following are the chief Causes which give rise to this condition

- 1 Strangulation by bands or adhesions or through apertures, etc
- 2 Volvulus
- 3 The impaction of foreign bodies
- 4 Acute intussusception
- 5 It may be the termination of a chronic obstruction
- 6 Acute localized paralysis of the gut due to an infective inflammation, *e.g.* acute suppurative appendicitis
- 7 Acute enterospasm

It will be noted that in the first five of these causes where the ileus is primary, there is a definite vascular lesion in addition to the obstruction which threatens the patient at an early date with perforative ulceration or gangrene, and it is mainly on the presence of this element that the acuteness of the case depends

The General Symptoms of acute obstruction are very similar to, if not identical with, those of strangulated hernia The patient is suddenly seized with severe abdominal pain somewhat of the character of colic, and perhaps referred to the umbilicus, coming on sometimes during some special effort, *e.g.* lifting a heavy weight or at other times when lying quietly in bed If internal strangulation is present he suffers from shock, as evidenced by a weak pulse, pale face, and cold clammy sweat, the temperature of the body falling below the normal, but this

usually passes away in a little time. When there is no strangulation there is no incipient shock. The pain however remains and is liable to exacerbations and intermissions but soon becomes continuous. Vomiting ensues and is very marked and persistent and there is absolute constipation neither flatus nor faeces passing. Distension of the abdomen is not necessarily an early sign but varies in character with the cause and site of the trouble. Abdominal tenderness is also absent in the early stages. If with such symptoms the administration of one or more turpentine enemata within the first twenty four hours has no



FIG. 803.—STRANGULATION OF A COIL OF THE LOWER END OF THE ILEUM BY A BAND DEVELOPED IN THE NEIGHBOURHOOD OF THE VERMIFORM APPENDIX (KING'S COLLEGE HOSPITAL MUSEUM)

result a diagnosis of intestinal obstruction is justified and active operative treatment should be advised.

If however the case is allowed to progress naturally the vomiting begins to alter in its character becoming bilious, stercoraceous or even faecal. The distension of the abdomen increases but without rigidity or tenderness until at length peritonitis develops. Signs of general depression and exhaustion due to toxæmia follow in a short time the pulse becoming weak, rapid and thready, the temperature remaining subnormal (unless it rises as a manifestation of peritonitis) and the face pinched and drawn from dehydration of the tissues (*facies Hippocratica*). Finally if unrelieved by treatment the patient dies and usually within seven to ten days from the onset owing to exhaustion or perforative peritonitis. Constipation may be absolute from the first not even flatus being passed but at any time the lower bowel may empty itself and raise false hopes as to the prognosis.

The Special Forms of Acute Obstruction must now be considered
serialim

1 Strangulation by Bands or Adhesions through Apertures, etc.—
Causes—(a) *Isolated peritoneal bands and adhesions* are usually the result of old plastic peritonitis of a localized and chronic character. The greatest variety is met with in the appearance and situation of these adhesions: most frequently they are single and cord-like; sometimes they are broad and membranous, constituting a false ligament; or again they may be multiple. A common situation is between different parts of the mesentery, or between the mesentery and some other viscus, the cause being either disease of that viscus (usually a pelvic organ, the cæcum, or the appendix) or inflammation of a mesenteric gland with localized peritonitis. Whatever the exact cause, the mischief is most frequently found either in the right iliac fossa or in the pelvis. Two methods of producing strangulation exist: either the bowel passes under the arch or loop formed by a short constricting band and cannot return (Fig 803) or if the band is long it may constitute a loop or noose through which the bowel passes and so becomes strangled (Fig 804). (b) *Cords connected with the omentum*: result from union between its fimbriated extremities and some part of the viscera or parietes, forming at first a broad band-like adhesion which is gradually moulded into a rounded cord by the constant dragging and pulling to which it is subjected. They are usually coarse and thicker than those due to peritonitis. The mechanism of strangulation is identical, the noose variety being perhaps the more common, since the adhesions are likely to be longer. (c) *Meckel's diverticulum* is liable to cause strangulation when its free end becomes adherent either to the parietes or to the viscera: it is attached most frequently to the mesentery of the ileum, and after that to the neighbourhood of the umbilicus. Occasionally the diverticulum ends in a fibrous cord which may remain fixed to the umbilicus, or floats free in the abdominal cavity, and subsequently becomes adherent to some other structure, thus producing a fibrous cord. Strangulation may be effected by bowel passing under a loop formed by the adherent diverticulum.



FIG. 804.—STRANGULATION OF THE SMALL INTESTINE IN A CHILD BY A BAND ADHERENT TO A MESENTERIC GLAND (UNIVERSITY COLLEGE HOSPITAL MUSEUM.)

(d) The vermiform appendix *appendices epiploicae* or Fallopiian tubes may contract abnormal attachments and thus form arches or loops under which bowel may pass and become strangled. (e) *Slits pouches and apertures* in the peritoneal investment whether normal or abnormal may lead to strangulation. All external herniae may be grouped under this heading as also those conditions known as *internal hernia* in which the abdominal contents find their way into pouches in the posterior wall of the peritoneum *eg* into the lesser sac of the omentum the fossa duodeno-jejunalis or into some of the retrocaecal fossae. Slits may also be found in the omentum or mesentery either congenital traumatic or the result of operations.

Phenomena.—This form of obstruction usually occurs in young people and is rare after forty. It constitutes more than a fourth of all the forms of internal obstruction and the lower 2 feet of the ileum are most frequently involved. There may be a previous history of peritonitis but that may have been overlooked or forgotten the onset is usually sudden and the symptoms of strangulation as detailed above are of a typical character. The abdomen is flaccid at first and not tender until peritonitis ensues on about the third or fourth day. There is generally no obvious tumour and no peristalsis or dilated coils of intestine are to be seen. Occasionally an area of localized fulness or of fixed and limited tenderness may indicate the site of the lesion. The average duration is about five to seven days the patients dying of exhaustion or toxæmia following peritonitis.

2 **Volvulus** is the most common cause of acute primary obstruction of the large intestine. By it is meant a rotation of the gut upon its own mesenteric axis in such a way as to interfere not only with the passage of the intestinal contents but also sooner or later with the circulation determining a condition of strangulation. Occasionally a similar result is brought about by the intertwining of one coil usually of small intestine with another. The sigmoid flexure is the part generally affected although it occurs in the cæcum when there is a definite mesentery or in the small intestine. In the former situation it is predisposed to by a long narrow sigmoid meso-colon so that the two ends of the loop are brought closely together this condition may be of congenital origin but is usually due to the traction induced by prolonged chronic constipation a distended sigmoid hanging into the pelvic cavity drags upon and elongates the meso-colon thereby approximating the two ends of the loop and necessarily causing a slight obstruction at these spots. Some irregular movement of the gut or of the abdominal walls suffices to cause rotation of the pedicle and thus brings about the volvulus. When once present plastic peritonitis soon fixes the coil and then the pressure on the vessels causes venous congestion and such obstruction to the arterial supply of the gut as almost certainly to end in its death. Distension of the coil with gas from decomposition of the retained faeces aggravates the condition.

Symptoms.—Volvulus is rare before the age of forty and apparently occurs more often in the male sex. A history of chronic constipation precedes it but the acute symptoms start abruptly. Pain is always present at first intermittent but finally constant and there is

usually tenderness over the sigmoid flexure. The pain, vomiting and collapse are not so severe or marked as in other forms of strangulation, but abdominal distension from excessive flatus, and resulting dyspnoea and thoracic embarrassment are very distressing. Tenesmus is occasionally present. A localized peritonitis is usually developed, but sometimes it becomes diffuse. Natural cure is unknown, the patient dying either in five or six days from collapse and interference with respiration, or at a somewhat later date from peritonitis.

3 **Impacted Foreign Bodies**, which may cause intestinal obstruction are of three types: gall stones, foreign bodies that have been swallowed or intestinal concretions (enteroliths). The general facts connected with their presence in the intestine have been already noted.

Gall stones only cause obstruction when of large size and then usually gain entrance to the intestine by ulceration from the gall bladder into the duodenum (Fig 805). The usual site of impaction is in the lower ileum. Women over seventy are most often the subjects of this condition and there may be merely a history of some inflammatory lesion in the region of the gall bladder and none of biliary colic. These patients frequently suffer from intermittent colicky pain together with subacute attacks of incomplete obstruction, which though severe for a time pass off. Sooner or later a final acute attack supervenes which begins suddenly with pain followed by vomiting which is constant and copious, and in twenty-four to thirty-six hours becomes faecal. The obstruction is often incomplete, flatus and even faeces being occasionally passed. The abdomen is soft and flaccid and the affected coil and the gall stone are rarely to be felt. Necessarily the symptoms vary with the site of impaction, usually becoming more urgent as the duodenum is approached. Death results from peritonitis or exhaustion.

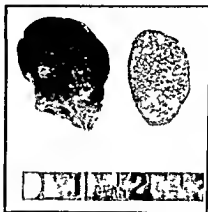


FIG 805.—TWO LARGE GALL STONES REMOVED FROM THE ILEUM

4 Acute obstruction ensues when a coil of intestine lodges across a tightly drawn adhesion, the lumen at each end being thereby entirely occluded and the circulation arrested. The usual acute symptoms follow, which may, however, be relieved spontaneously. Sudden kinking of the gut may lead to the same result, being due to the contraction of fibrous adhesions or the dragging of diverticula.

5 For **Acute Intussusception**, see p 1327.

6 When acute symptoms are developed at the termination of a case of chronic obstruction, the pain which had been intermittent becomes constant, the vomiting more violent and faecal in character, and the fatal termination is due to acute peritonitis, or to exhaustion.

and toxæmia Absolute constipation is always present, and the abdomen much distended

7 True obstructive phenomena are sometimes associated with acute localized intraperitoneal lesions, such as appendicitis, cholecystitis, or pelvic inflammations, where the bowel wall is paralyzed as a result of peritonitis The symptoms are often very characteristic, and fecal vomiting may even occur, but by careful attention to the history and general condition of the patient a correct diagnosis should be reached. The following table illustrates the chief diagnostic points between acute strangulation and acute appendicitis associated with peritonitis, one of the commonest causes of dynamic ileus

	<i>Acute Internal Strangulation</i>	<i>Acute Appendicitis with Peritonitis</i>
Onset	Abrupt	May be preceded by local pain
Rigor	Absent	Often present
Temperature	Subnormal at first rising at onset of peritonitis	High at first falling later from exhaustion or toxæmia
Pain	Severe referred to the umbilicus	Severe usually referred to the right iliac fossa
Tenderness	Absent till peritonitis comes on	Present over caecum even in early stages and gradually spreading
Vomiting	Early marked and soon fecal	Less urgent and seldom fecal except as a late symptom
Abdominal parietes	Flaccid till peritonitis is present	Tense and rigid from the first

In the other forms of dynamic ileus the obstructive phenomena are usually secondary to some peritonitic trouble or to some intra-abdominal lesion which produces its own symptoms first and then obstructive phenomena only as a secondary result of inflammatory paralysis. Thus in torsion of the pedicle of an ovarian cyst, the patient first complains of pain and the tumour becomes large and tender. Should it be neglected aseptic peritonitis ensues after a variable period intestinal paralysis follows, and obstructive symptoms of a distressing type are produced which are likely to prove fatal, even if the cause is removed.

8 *Enterospasm* is the name applied to a functional disorder occurring in patients of a neurotic type in which one or more sections of the intestinal canal undergo purposeless tetanic contraction. The colon is more commonly affected than the small bowel and especially the caecal and sigmoid sections. In the acute form the symptoms of urgent obstruction may be produced and even peritonitis simulated, but more frequently the attacks are *chronic, and persistent constipation* results. Sometimes the appendix is tender, and has been removed for this affection without benefit. Anti-spasmodics of the belladonna type are required and purgatives do but little good.

For diagnosis and method of examination of cases of acute obstruction see p 1331

The Treatment of acute obstruction is practically included in one word—Laparotomy. The condition of the gut is in most cases identical with that found in a strangulated hernia, and although a few patients may recover by palliative measures, *eg* enemata, opium, ice, etc., yet the majority would be gravely injured by the delay caused by their employment. The danger of laparotomy increases directly with delay, hence, the sooner it is undertaken, the better for the patient. Whilst preparations for the operation are being made, an enema may be administered to clear the lower bowel, ice being given to suck, and a small dose of opium to relieve urgent pain.

Attention has recently been called to the absence of chlorides in the blood of these cases, and as a preliminary to operation saline should always be given either subcutaneously or intravenously. Marked improvement follows this procedure, and frequently desperate cases can be operated on and stand operation, which without the administration of chloride would have had little chance of recovery.

Two main objects must always be striven after in the operative treatment of such cases, *viz* (a) to empty the distended bowel, and (b) to remove the cause of the obstruction. The second of these requisites is always most desirable, but unless at the same time the putrid contents of the upper portion of the intestine are removed, little real good has been accomplished since the patient is being slowly poisoned by toxic absorption. Hence, in many cases it is desirable to deal first with the engorged bowel by establishing an artificial anus, and to leave the search for the obstructing body till a later date. A high death rate must always be expected, statistics show this to be about 40 per cent, but there is no doubt that where the cause of the obstruction is not at once obvious primary enterostomy, if followed by a satisfactory discharge of the intestinal contents, gives results in many instances equal to, or even better than, treatment directed towards the cause of the trouble.

In the *most urgent cases*, where the patient's abdomen is acutely distended, and faecal vomiting has been present for some time, it is not advisable to administer a general anaesthetic, if this is attempted, the patient's life is often lost from stoppage of the respiration, precipitated possibly by a severe attack of faecal vomiting. Local infiltration anaesthesia must be relied on, or spinal analgesia. The stomach should always be washed out with a weak alkaline solution as a first step in the operation. If it is probable that the obstruction is in the small intestine, (1) a small incision is made through the linea alba below the umbilicus, the first presenting coil of intestine is withdrawn, and after protecting the peritoneal cavity with gauze or swabs, is tapped with a large trocar and cannula so as to allow the first gush of flatus and faeces to be carried away from the wound. The opening is then enlarged sufficiently to allow a rubber or Paul's tube to be introduced and tied in, and whilst the bowel is emptying itself, it is fixed by stitches to the abdominal wall. (2) A form of practice which has been much recommended of recent years consists in undertaking *jejunostomy* as a preliminary measure. A rubber tube of moderate size is tied into the selected coil of jejunum through a supra umbilical incision by purse-

string sutures in the same way as for a Senn's gastro-tomy. It is fixed by a couple of stitches to the parietal peritoneum and sheath of the rectus, and through it the dilated intestine is able to empty itself of its putrid contents. The patient is put back to bed, and the gut frequently irrigated with a solution of bicarbonate of soda to which glucose is sometimes advisably added, and the intestinal contents can then be aided in their escape by syphonage. In a few days it is possible that the gut will be completely cleared of its foul contents down to the site of the obstruction, vomiting will cease, and the patient's general condition will be so improved that operation to deal with the cause is justified. (3) If the cause is in the large intestine a cæcostomy should be performed as described and the local lesion dealt with later.

Even in *less severe cases* the stomach should be washed out as a preliminary before administering an anæsthetic. The head must never be placed on a lower level than the stomach for fear of fluid regurgitating along the œsophagus and choking the patient, several deaths from this cause have been reported. The abdomen is then opened below the umbilicus and a definite search made for the cause of the obstruction if it is not at once obvious. The hand is first passed to the hernial regions and then to the right iliac fossa, so that the cæcum may be examined. If this is distended the cause necessarily lies below it; if collapsed above it. In the former case, the condition of the sigmoid flexure should next be investigated, and finally, if this viscus is collapsed, the hand should be run along the colon, special attention being directed to the splenic flexure. If the cæcum is collapsed perhaps the best method to adopt is gently to withdraw from the abdomen successive portions of gut about a foot at a time. These are carefully examined and replaced by the assistant whilst the next portion is being withdrawn. The remainder of the intestines during this process are protected and kept back by the application of hot sterilized abdominal cloths. The cause of the obstruction is in this way sooner or later discovered, and may be dealt with according to circumstances.

Omental bands or peritoneal adhesions should be divided between ligatures. The vermiform appendix may be removed, or a Meckel's diverticulum excised. A volvulus should be untwisted if possible, but this may be impracticable, owing to peritoneal adhesions and in such cases it is advisable to withdraw the coil from the abdomen, and if the large intestine is involved an artificial anus should be made. Foreign bodies are, if possible, displaced forwards or backwards to a more healthy portion of the bowel and then removed by a longitudinal incision along the anti-mesenteric border, the wound being subsequently closed transversely by a row of Lembert's sutures. Of course, volvulus of the small intestine or gangrene of the gut, if present, may necessitate an enterectomy, but it must always be kept in view that the essential feature of the operation is drainage of the intestine and therefore the establishment of an artificial anus as a temporary measure is often desirable. re-union can be effected when the gut has emptied itself.

In all cases it must be remembered that the toxic phenomena are largely due to the absorption of the products of the activity of anaerobic organisms of the *B. perfringens* (Welchii) type and good results have followed the administration of the antitoxin

Chronic Intestinal Obstruction

The Causes of chronic obstruction are very numerous and looked at from an anatomical standpoint may be divided into the following groups

1 Intra intestinal conditions *e.g.* impaction of faeces foreign bodies etc

2 Affections of the intestinal wall such as stricture new growths especially those of a cancerous type adhesions or matting together of coils of intestine contraction or kinking of the gut from mesenteric gland disease etc

3 Compression of the bowel by tumours cicatricial bands etc developing outside the intestine

Faecal impaction and the development of a cancerous growth are far and away the commonest causes of chronic obstruction

The General Symptoms of chronic obstruction are more or less as follows. The patient suffers from gradually increasing constipation alternating occasionally with watery diarrhoea spurious in nature and set up partly by a catarrhal enteritis due to the irritation of retained faeces partly by decomposition of the faecal material. At irregular intervals more severe symptoms arise consisting of pain colic vomiting and absolute constipation owing to some temporary complete obstruction as by the impaction of a mass of undigested food or faeces assisted perhaps by a valve-like fold of mucous membrane across the passage. The abdomen becomes distended and coils of gut may be seen in a condition of active peristalsis. These attacks usually pass off after a time a copious evacuation of the bowels taking place either naturally or after the administration of a purgative. Finally one of these seizures persists and destroys the patient either by exhaustion or by perforation followed by peritonitis unless suitable treatment is promptly adopted. The vomiting is never such a marked feature as in acute obstruction until the final stage when it becomes faecal. The abdomen is always more or less distended and tympanitic and its contour varies with the site of the obstruction. If this is situated above the ileo-caecal valve the swelling is mainly central but if in the rectum or lower portion of the colon it is most marked in the flanks. Distended coils of intestine can be plainly seen through the abdominal walls in thin subjects as also evident peristalsis. When arising from simple stricture no tumour is to be felt but if due to malignant disease and if the abdomen is not very distended the growth may possibly be detected.

Faecal Impaction occurs in adult females who have previously suffered from chronic constipation. The caecum and sigmoid flexure are the most common seats of obstruction but the transverse colon is not unfrequently affected (Fig 806). A doughy tumour may often

be felt at one of these spots which can in some cases be indented with the fingers whilst in others it may be of stony hardness. The surface of the mass is usually more or less nodulated and the intestine tender from the accompanying inflammation. The temperature is often raised from toxic absorption through the intestinal wall and there may even be a rigor. The acute symptoms are always preceded by a prolonged period of malaise and ill health the appetite being defective the breath offensive and the tongue foul. On rectal examination the presence of scybala may often be detected.

The special symptoms arising from the other conditions which give rise to chronic obstruction such as stenosis of the bowel have been already referred to.

The Diagnosis of chronic obstruction is obvious but it is often by no means easy to ascertain the exact cause of the trouble. A thorough investigation of the case according to the plan given hereafter must be undertaken and by this means some conclusion may be arrived at as to the nature and seat of the obstruction.



FIG. 806.—DIAGRAM TO INDICATE THE USUAL SITES OF FÆCAL IMPACTION—VIZ. THE CÆCUM TRANSVERSE COLON AND SIGMOID.

The Treatment of chronic obstruction is always a matter of difficulty and anxiety owing to the uncertainty often felt as to the diagnosis. It ought to be possible however to decide whether the block is located in the large or small intestine since the character of the abdominal distension and the symptoms are tolerably distinctive in the two forms.

If the case is not of the most urgent type the patient is put to bed the diet restricted to fluids and belladonna administered. At the same time copious enemata should be given two or three times daily and preferably in the genu-pectoral position or lying on the right side.

Purgatives are studiously avoided as also opium probably the patient has taken plenty of the former before coming under observation whilst the latter although it may check vomiting and relieve pain is certain to mask symptoms and thus prevent the true course of the disease from being watched. Should the symptoms be urgent from the commencement or the treatment suggested fail the question of operation has to be faced. If the obstruction is located in the small intestine a laparotomy must be undertaken using the same precautions as in acute cases. If the cause of the trouble is easily found a coil situated just above is withdrawn from the abdomen opened and a Paul's tube tied in so as to allow retained fæcal material to escape. It is wiser not to deal with the local trouble until the urgent symptoms have disappeared. If however the patient's condition is serious and the site of obstruction cannot be readily found, any distended coil (ileum or jejunum for choice) may be withdrawn and opened. The practice of allowing numerous coils of intestine to

escape in order to facilitate the exploration of the abdomen is not to be recommended

When the cause of the obstruction is located in the large intestine above the pelvic colon cæcostomy is usually required, followed by excision at a later date. If the rectum or sigmoid flexure is clearly the seat of the trouble, iliac colostomy is the operation of choice. When there is no indication as to the part of the colon involved, cæcostomy should be undertaken as a preliminary measure.

In chronic peritonitis, where the intestines are hopelessly matted together but little can be done beyond the administration of enemata and possibly abdominal massage. The history of the case will generally suffice to suggest its nature, and operative treatment should then be avoided.

Fæcal impaction requires the regular and repeated administration of large enemata, given through a long tube, and belladonna together with calomel may also be administered. Should hard scybala be lodged in the rectum, it may be necessary to break them up *in situ* and remove them piecemeal.

Intussusception.

By **Intussusception** is meant the protrusion or invagination of one part of the intestine into another, giving rise to the condition illustrated in Fig. 807. The constituent parts are seen more diagrammatically in Fig. 808. The upper portion is always prolapsed into the lower, except occasionally during the irregular peristalsis which takes place during the death throes. The invaginated portion (*a*) is known as the *intussusceptum*, whilst the lower portion (*b*) into which it is protruded is known as the *intussusciens*. An intussusception, then, consists of three layers—the outer or *ensheathing* layer (*i*), an inner or *entering* layer (*m*), and between the two the *returning* layer (*u*). Not only does the intestine enter, but with it a certain portion of the mesentery, and it is to the constriction of the vessels contained therein, and later on possibly to their complete obstruction, that the more serious phenomena are due, *e.g.* gangrene, perforation, or rupture of the gut. In addition to this, actual obstruction to the passage of the intestinal contents may be brought about by the traction of the mesentery, which renders the orifice of the intussusceptum slit like, by the swelling and congestion of the intestinal wall, or perhaps by the impaction of a portion of undigested food within the lumen of the gut. Peritonitis usually follows, being possibly due to the invasion of a portion of the damaged intestinal wall by the *B. coli* or other intestinal organisms. If limited in extent, it may merely lead to irreducibility of the intussusception, owing to adhesions forming between the serous coats of the entering and returning layers. In other cases, and especially when ulceration or gangrene is present, a diffuse peritonitis may be lighted up, and this may result in the death of the patient. The bowel above the site of invagination becomes dilated in the more chronic cases, and possibly stercoral ulcers may then develop.

The Cause of intussusception is generally stated to be irregular

and violent peristalsis however induced whether by the presence of irritating ingesta or by the existence of polypoid tumours malignant growths (Fig 809) or possibly worms the presence of scybalous masses of faeces may also lead to its occurrence. In a few cases injury *e.g.* blows on the abdomen or severe strains during jumping have been held responsible for its onset but very frequently no cause can be assigned.

Intussusception is met with in four chief situations (1) The *ileo-cæcal* variety is much the commonest constituting 44 per cent of all cases. In it the ileum is protruded into the colon the apex of the intussusceptum being formed by the ileo-cæcal valve. Owing to the great mobility of the ileum a considerable portion of gut may be thus in



FIG 807—INTUSSUSCEPTION (ROYAL COLLEGE OF SURGEONS MUSEUM)

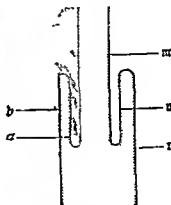


FIG 808—DIAGRAM OF INTUSSUSCEPTION

a Intussusceptum b intussuscipiens I ensheathing layer II returning layer III entering layer

vaginated and a good many cases have been observed in which it has actually projected through the anus. (2) The *enteric* variety involving the small intestine comes next in order of frequency being met with in 30 per cent of the cases. It is most often seen in the lower jejunum and is rarely of great size. (3) The *colic* form may occur at any part of the colon or rectum and owing to the fixity of this portion of the gut is limited in extent. It is met with in about 18 per cent of the cases. (4) The *ileo-colic* only occurs in 8 per cent in it the ileum is prolapsed through the ileo-cæcal valve which for a time retains its normal position but after the intussusception has attained a certain size the valve and cæcum are also invaginated into the ascending colon. In each of these varieties except the last the intussusception grows at the expense of the external or ensheathing layer the apex of the protrusion being always formed by the same portion of gut but

in the ileo-colic variety, as just stated, it increases by the passage of more and more of the ileum through the valve, after a time this stops, and is replaced by the ordinary type of growth

Intussusception is occasionally met with as a *post mortem* phenomenon, resulting from the irregular intestinal movements which occur during the death crisis. The condition is recognized as being of this nature by the absence of inflammatory signs, by the fact that it is sometimes due to a reverse peristalsis and by more than one intussusception being present

The Clinical History varies according to whether the condition is acute or chronic

Acute Intussusception occurs most frequently in infants under two years being the most common cause of obstruction at this age. The onset is sudden, the child being attacked with severe pain, possibly localized and more or less paroxysmal at first, but rapidly becoming continuous and diffused over the abdomen. This is followed by vomiting, which, however, is less severe than in acute strangulation, and not so often *faeculent*. The patient rarely suffers from absolute constipation, but diarrhoea and the discharge of blood-stained mucus, perhaps associated with tenesmus, and often without faeces, are common. Collapse soon supervenes, and in the worst cases this may be so severe as to kill an infant within twenty four hours, otherwise a fatal issue from exhaustion or peritonitis is reached within a week. On examining the abdomen, but little distension or tenderness is noticed unless acute peritonitis is present, in more than half the cases a distinct tumour can be felt, cylindrical in outline, and sometimes described as 'sausage-shaped', following the course of the intussusception and generally curved, owing to the traction of the mesentery. In the ileo caecal variety it extends from the right iliac fossa across the brim of the pelvis to the left, the colon being dragged downwards. This may be associated with an absence of resistance in the right fossa, which feels empty, constituting what is known as the 'signe de Dance'



FIG 809 — HYPERTROPHIC CANCER OF THE CAECUM INVAGINATED INTO THE TRANSVERSE COLON

This growth was successfully removed and an ileo-colostomy performed. The patient was alive and well ten years later

In other cases the tumour may be more limited, and distinctly movable. The rectum should always be carefully examined, and preferably under an anæsthetic so as to permit a thorough bimanual examination of the rectum and abdomen to be made.

A natural cure occasionally follows, resulting either from spontaneous reduction, or from sloughing of the intussusceptum, the peritoneal cavity is then shut off by a circle of plastic lymph uniting the ensheathing and entering layers of the gut. When the latter takes place, the subsequent condition is not very satisfactory, owing to the formation of a fibrous stricture.

Chronic Intussusception occurs more frequently in adults than in children the onset being gradual and the course varying widely in different cases. The patient complains of intermittent attacks of pain of a colicky nature, which recur at intervals, and become more frequent and prolonged as the case progresses. Vomiting is often but little marked during the intermissions. The bowels are irregular in their action, and there is sometimes a blood stained mucous discharge. The general condition is not at first much affected, but as the case progresses, emaciation and general asthenia may supervene. On examination, the abdomen is found to be flaccid and free from tenderness, although visible coils of intestine may be observed in some cases, and perhaps a tumour felt. The symptoms are rather those of subacute enteritis and chronic obstruction than of strangulation, and the case may be brought to a fatal termination either by an acute attack of obstruction or by peritonitis. It may, however, last a long time before being recognized.

Treatment—In acute intussusception the patient should be at once placed under the influence of opium, in order to still peristalsis and prevent the increase of the tumour. Inflation of the bowel with air, or the injection of copious enemata of warm water or oil, is sometimes recommended, but no undue force should be employed. It is performed by raising the patient's pelvis and inserting into the rectum a catheter, with which is connected an indiarubber tube and funnel, held about 1½ or 2 feet above the abdomen. Should this not succeed, laparotomy should be performed without delay, and, indeed, where skilled surgical help is available, operation is usually relied on solely. Babies have but little power of resistance, and therefore rapidity combined with gentleness of execution is an essential element for success. If the infant is in a state of shock, hypodermic injections of saline solution should be administered and the child must be kept very warm. Gas and oxygen with local novocaine infiltration is the best form of anæsthesia. A vertical paramedian incision is the best, and no undue escape of bowel should be permitted. The swelling when found is, if possible, drawn up outside the abdomen, and reduction is attempted by manipulation. The *intussusciens* is grasped and compressed by the palm of the left hand, and the right hand steadies the *intussusceptum*. Gradually, by a mixture of pressure and kneading, the *intussusceptum* is delivered from the grasp of the *intussusciens*, but no attempt must be made to pull out the *intussusceptum*. Complete freedom is essential if there is to be no recurrence, and the last dunple may be difficult to obliterate.

In a small percentage of cases reduction by manipulation is impossible owing either to œdema of the bowel or adhesions and then if the general condition of the patient is fairly good the intussusception should be removed and the divided ends of the bowel united by suture. If however the patient is in a condition of profound shock all that can be done is to fix the bowel in the wound and make an artificial anus. The results of these procedures are anything but encouraging as it has been shown that few children recover if anything more than simple reduction is required during a laparotomy.

Chronic intussusception is more favourable in its prognosis. It is frequently unrecognized until an exploration of the abdomen is made and hence reduction by inflation is not commonly attempted. In some cases the tumour may be reduced by simple manipulation but as a rule too many adhesions are present. Excision of the mass should then be undertaken and the results gained have been very encouraging.

Diagnosis and Method of Examination of a Case of Intestinal Obstruction

A grave responsibility rests upon the medical attendant in every case of obstruction. The condition is incompatible with life beyond a few days and the time occupied in observing the patient and making up one's mind as to the nature of the case is valuable time lost which may ruin the patient's chances of recovery. There are three things to be avoided in conducting a case of this nature (i) *Purgatives*—The patient has probably taken plenty before sending for assistance and the only result to be expected is an increase of pain and vomiting. (ii) *Opium* has its place in the treatment of obstruction *viz* in relieving the agony associated with its onset but beyond this it merely masks symptoms and can do no good but comfortably to conduct the patient to the grave. It causes intestinal paralysis and therefore may check the most distressing symptom vomiting but it aggravates the condition which needs treatment. (iii) *Delay* in sending for surgical assistance is responsible for more deaths than is the condition itself. When once the gut has become generally paralyzed there is but little hope for the patient.

In the investigation of a case various problems of some difficulty have to be solved and it is well to undertake this task methodically.

1 The medical attendant must satisfy himself that obstruction is actually present and not merely aggravated constipation. In the latter however flatus passes readily and the general condition is not much impaired. As already mentioned when complete arrest of flatus and fæces has lasted for twenty-four hours and especially if turpentine enemata have been administered during that period a diagnosis of obstruction is justified and if abdominal pain and vomiting co-exist the presence of some serious lesion is certain.

2 It is essential to determine whether the obstruction is *dynamic* or *mechanical*. The differences and distinctions between these have been already alluded to.

3 The question as to whether the lesion is *acute* or *chronic* must

next be settled. Initial severe pain and collapse, the rapid onset of vomiting, a localized spot of fixed tenderness, and the quick depreciation of the patient, all point to some acute vascular lesion of the intestinal wall, which will prove fatal in a few days unless suitably treated. On the other hand, chronic cases are often preceded by constipation and other troubles of defæcation; they come on gradually and are at first unaccompanied by constant pain and vomiting, although colic of a severe type may be present. The examination of the abdomen is also of the greatest assistance. In acute cases intestinal paralysis dominates the picture; in chronic cases vigorous peristalsis can be felt and often seen, unless the patient has been left too long.

4. An effort must be made to determine the *site and nature* of the lesion. As to the question of site, the following points may be noted.

(a) When the *upper part of the small intestine* is involved, the vomiting is early, tumultuous, and persistent; the vomit is bilious, but not faecal. Abdominal distension involves the epigastrium and particularly the stomach. The lower part of the abdomen may be retracted. Collapse is early and rapidly increases. The thirst is terrible; the urinary secretion is slight or even suppressed; gas and faeces may pass from the lower bowel.

(b) When the *lower part of the small intestine or cæcum* is involved, faeces and flatus cannot pass; the vomiting becomes offensive, and later faecal; meteorism is marked and involves the central part of the abdomen, the flanks not being affected. In chronic cases peristalsis is very evident.

(c) When the *colon or rectum* is the site of obstruction, the symptoms are more chronic as a rule, and even in acute cases, such as volvulus, the initial collapse is slight. Vomiting is later in appearing, but may of course become faecal. Meteorism may be very marked and involves the flanks as well as the centre; sometimes it is possible to recognize that the lesion is not lower than the splenic flexure by distension of the left flank being absent. The condition of the cæcum must be carefully investigated, for on it the stress of all large intestine obstruction falls. It is sometimes possible to see that it is distended, and on palpation it may be felt to harden under the examining hand. Under these circumstances a diagnosis of a block below the ascending colon can usually be ventured.

The determination of the *nature* of the case will largely turn on the patient's previous history, and not uncommonly one has to admit that, although one can locate the site of mischief, there is no clue as to its nature beyond the generalizations learnt from statistics.

The actual examination of the patient is carried on along the following lines:

1. The *Previous History* of the case should be carefully gone into in order to ascertain whether or not the patient has suffered from biliary colic, chronic constipation, acute diffuse or localized peritonitis, uterine derangements, syphilis, or dysentery, etc.

2. The *History of the Present Attack* should then be ascertained, noting especially the manner of onset, whether acute or gradual, the

duration of the symptoms and whether or not preceding subacute attacks have occurred from time to time

3 The more prominent **Symptoms** must then be considered

(a) *Collapse* is due partly to reflex nervous disturbance, partly to the absorption of toxic materials and partly to withdrawal of fluid from the body as a result of the vomiting, the portal area is also much engorged and this adds to the want of fluid in the systemic circulation. The nervous cause is most active in the early stage of acute obstruction, especially in infants, whilst the toxic is largely responsible for the exhaustion seen at the end of an acute attack or in the chronic variety. Hence collapse is early in acute cases, late in chronic. Moreover, the higher the lesion the greater the shock, owing to the fact that the upper portion of the bowel is more intimately associated with the sympathetic nervous centres.

(b) *Pain* is a very marked symptom being usually referred at first to a little above the umbilicus and is more severe in lesions of the small intestine than in the colon. It varies greatly with the completeness or not of the obstruction. When the obstruction is only partial, the pain is intermittent, but when the block is complete, the pain becomes continuous. Hence in acute strangulation pain is almost invariably constant, whereas in stricture it is markedly intermittent and of a colicky nature. The amount of pain, moreover, varies with the nervous excitability of the patient. It is increased by anything which induces peristalsis, e.g. food or purgatives, and it is diminished on the supervention of gangrene.

(c) *Abdominal tenderness* is rarely observed in the early stages, being caused by the onset of peritonitis.

(d) *Vomiting* is an almost invariable accompaniment of obstruction. Its cause has been already discussed. When the obstruction is situated in the jejunum or upper part of the ileum, the vomiting is never absolutely faecal, although, if it has been temporarily checked by opium, the ejecta may be exceedingly offensive and dark in colour, owing to decomposition, faecal or stercoraceous vomiting can only come from an obstruction to the lower ileum or colon.

(e) *Constipation* although usually present, is not necessarily absolute, as it is possible for the lower bowel to be emptied in cases of obstruction, whilst the patient sometimes passes a motion as gangrene supervenes or death is approaching.

4 A most careful **Physical Examination** must now be instituted

(a) *An inspection* of the uncovered abdomen should first be made. The amount and character of the distension is observed, and whether or not it is situated in the centre, as when the small intestine is involved, or in the flanks, when the obstruction is in the rectum or sigmoid flexure. The existence of visible peristalsis or enlarged coils of intestine should be noted, such are rarely seen in the acute cases but may be very evident in the chronic forms. Sometimes one coil remains persistently distended and always at the same spot, its appearance always suggests that the site of obstruction is not far away. Sometimes a series of distended coils are seen crossing the abdomen like a row of organ pipes. The rise and fall of the abdomen during

respiration should be watched to ascertain whether the movements are equal on both sides, or if any prominence, such as would be caused by a tumour, is noticeable. The general condition of the patient, whether emaciated or not, as also the appearance of the face and the position in which he lies, should be observed.

(b) All the normal and abnormal hernial apertures are thoroughly investigated and a careful examination made from the rectum and vagina.

(c) The abdomen is carefully palpated so as to ascertain the existence of any tumour or increased resistance of the abdominal walls.

(d) *Percussion* and *auscultation* may also throw light on the case.

(e) A rectal examination should always be done, as it frequently gives valuable information.

(f) Finally, in chronic cases, some information may be gained by the use of *enemata*. When the obstruction is low down and not far from the anus it may be impossible to introduce more than a small quantity of fluid and thus in spite of modifying the position. Too much reliance, however, must not be placed on this sign. It is also desirable to auscultate the colon during the administration of a large enema, it is sometimes possible to hear gurgling sounds as far round as the caecum, indicating that the large intestine is free from obstruction. We would call attention here to the fallacy of using a long tube in the expectation of being able to pass it into the sigmoid flexure. A careful study of the rectum and its valves will show the difficulty of this, whilst the use of the genu pectoral position renders it unnecessary.

CHAPTER XLII

AFFECTIONS OF THE RECTUM AND ANUS.

THE rectum from the anatomical standpoint consists of the lowest 5 inches of the intestinal canal, but for the surgeon it represents the lower 6 or 8 inches, which can be reached more or less from the anus

Examination of the Patient.

The fact that a patient's symptoms are referred to the rectum does not obviate the necessity for a careful examination of the abdomen

Position of the Patient for Rectal Examination—The two positions which are used are the left lateral, in which the patient lies on the left

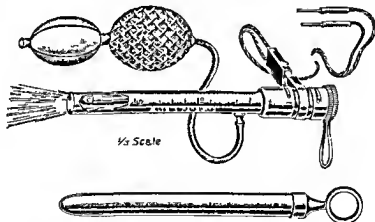


FIG 810—SIGMOIDOSCOPE

side with the left arm behind the back and the knees drawn up, and the knee elbow when the patient kneels on the couch, bearing the weight on the elbows and knees. The former is more comfortable and less embarrassing to the patient while the latter is useful in stout patients, or where sigmoidoscopy is to be performed.

Digital Examination—With a good light the condition of the anus and surrounding skin should first be carefully examined for skin changes tags the orifices of fistulae etc., and the anal margins gently separated to determine the presence of a fissure. The index finger, well lubricated and pressed against the lateral wall, is gently inserted. The majority of rectal lesions occur within the last inch of the bowel

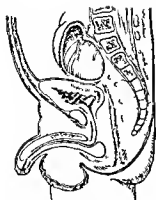


FIG. 811

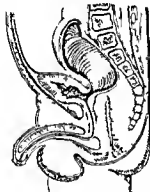


FIG. 812

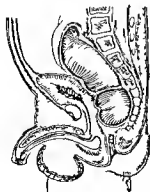


FIG. 813

After this has been carefully examined the finger is passed as far as possible and finally a bimanual examination is made.

Proctoscopy—There are many different forms of proctoscope the essentials of which are that it should give a good view and that its insertion and manipulation should not inflict pain. A good light is essential and this may be obtained by the use of a head lamp or a light fixed to the base of the proctoscope. In this way the lower 4 inches of the bowel can be examined.

Sigmoidoscopy is employed for examining the upper part of the rectum and the lower sigmoid. The instrument (Fig 810) consists of a hollow straight tube 14 inches long with its length marked on the outside so that one may know how far it has been introduced. Suitable arrangements are made for distending the bowel with air and for illuminating and seeing its interior. An obturator is used to facilitate its introduction in the first instance but this is withdrawn when it is within the bowel.

Congenital Malformations of the rectum and anus are fortunately extremely rare. At an early stage of fetal life the lowest part of the hindgut is a common chamber the cloaca into which the allantois opens in front and the hindgut above. With development the hindgut grows backwards beyond its cloacal opening forming the post allantoic gut and its communication with the cloaca becomes closed. The cloaca forms no part of the rectum but becomes the trigone of the bladder. The post allantoic gut acquires its communication with the outside of the body by its junction with an epiblastic ingrowth from the perineum known as the proctodeum.

FIGS 811-813.—THREE VARIETIES OF MALFORMATION OF RECTUM

In Fig 811 the bowel ends at the brim of the pelvis in a cul-de-sac and there is no evidence of an anus. In Fig 812 the anus is absent and the bowel opens into the bladder. In Fig 813 the anus and bowel are only separated by a thin septum.

The rectum and anus are thus developed from three distinct embryonic structures (1) the hindgut (2) the post allantoic gut (3) the proctodeum. In the adult the junction of (1) and (2) is at the reflection of the peritoneum from the anterior surface of the rectum and that of (2) and (3) at the level of the anal sinuses. Failures in typical development result in various clinical types of malformation.

(1) The original communication with the cloaca may persist. In the male the usual situation is in the region of the trigone or the prostatic urethra (Fig. 812) in the female in the posterior vaginal wall. This condition is usually associated with

(2) Non development or arrested development of the post allantoic gut. Here the rectum may end at the level of the peritoneal reflection with or without a communication or a fibrous cord attaching it to the prostatic urethral vaginal or anal region. The anus in these cases may be normal, absent or mal developed.

(3) Imperforate anus. A complete membranous septum may persist between the post allantoic gut and the proctodæum placed about an inch from the anal verge and bulged downwards by retained meconium or it may have been partially obliterated forming a stricture.

The Treatment of these cases must be instituted at once. Anal stenosis is treated by dilatation with the finger or bougies. Where only a membranous septum persists between the rectum and anus this should be incised and cut away followed by the regular passage of the finger or bougies to prevent stenosis. When the anus is absent whether or not there is any indication of a rectum such as bulging in the perineum or crying the child is placed in the lithotomy position and a perineal incision is made through the site of the anus and carried upwards and backwards along the concavity of the sacrum strictly in the middle line for not more than 2 inches. It is an open question whether it is justifiable to proceed further by removing the coccyx and part of the sacrum since the membranes of the spinal cord extend much further down in the infant than in the adult. If found the dilated and bulbous cul-de-sac is drawn down as far as possible and opened towards its posterior aspect the mucous membrane is then if feasible stitched all round to the skin so as to leave no surface to granulate thereby preventing subsequent stenosis. In cases where no rectum is present *iliac colostomy* must be performed. When once a passage for the feces is established abnormal openings into the bladder etc. usually close without difficulty. In a female infant the rectum may open into the vagina and if the opening is sufficiently large no immediate operation is necessary. An operation can subsequently be performed when the child is much older.

Various malformations in connection with the post anal gut have been already described.

Injuries of the rectum are usually due to falling on some pointed body such as a stick or railing or upon a piece of broken china but are sometimes caused by the forcible introduction of foreign bodies by lunatics or criminals. They may merely involve the mucous

membrane or may pass through the perineal tissues enter the bowel and penetrating the upper wall lay open the peritoneal cavity. Hæmorrhage pain and shock follow and acute peritonitis if the serous membrane has been wounded. Inflammatory troubles may involve the peri rectal tissues and sinuses may result from suppuration. A thorough examination must be made under an anæsthetic and the wounds either sutured or left open to granulate. In women the recto-vaginal septum may be torn but the surgeon need be in no great hurry to interfere if the wound is but small as it often closes of itself if however the lesion is of some length immediate suturing may be desirable. If the peritoneal cavity has been laid open a laparotomy is usually required in order to cleanse it and close the wound if however the wound is small and the rectum at the time of injury empty it may be justifiable to delay interference till some sign of inflammatory reaction shows itself a piece of sterilized gauze in the rectal wound will often suffice to limit the inflammatory mischief. Peri rectal complications are dealt with as they arise. In serious lacerated injuries such as those which occur in war a colostomy is often required as a primary measure later when the injury to the bowel has been repaired the artificial opening may be closed.

Foreign Bodies are derived from various sources. Generally they have been swallowed and have traversed the intestinal canal. Fish bones and small tooth plates are most commonly seen and they usually lodge just above the anus in one of the so-called pouches of Morgagni. They give rise to severe pain especially on defæcation and possibly to some form of peri rectal abscess. Large gall stones are sometimes lodged in the lower end of the rectum just above the sphincter. Foreign bodies may be introduced from without, and cause various forms of traumatic inflammatory lesions.

Inflammation of the Rectum (Proctitis) causes pain of a bearing down character a sensation of fulness constantly recurring tenesmus accompanied by a discharge of mucus muco-pus or blood. It may arise from any local source of irritation e.g. the presence of foreign bodies or of a polypus parasites or piles gonorrhœa is an occasional cause—in women possibly owing to infection from the vaginal discharge in men probably from direct infection. In dysentery and in ulcerative colitis the rectum is often involved as well as the colon. Proctitis may have an acute or an insidious onset without apparent cause. If the inflammation becomes chronic a simple fibrous stricture may result. In acute proctitis the mucosa is œdematous inflamed and covered with muco-pus in chronic forms it is thickened granular and bleeds easily when touched with a probe. Ulcers are not commonly seen.

Treatment—Any exciting local lesion should first be excluded and a smear of the pus examined. In acute cases the patient is confined to bed and if necessary a starch and opium enema or belladonna and morphia suppositories given to relieve pain and tenesmus while liquid paraffin will prevent the formation of hard fecal masses. Rectal irrigations of saline or hazeline 2 drachms to the pint may be used and potassium permanganate in early gonococcal cases.

Chronic proctitis is often extremely resistant to treatment. Irrigations and the occasional local application of silver salts are used. Injections of bismuth subgallate (5 per cent) in olive oil and irrigation with zinc sulphate have been advocated (Lockhart Mummery). It is important to recognize and treat any secondary anæmia which may develop in these patients.

Thread-worms (*Oxyuris vermicularis*) are the most constant source of irritation of the rectum in infants and children. They give rise to pruritus ani, a discharge of mucus and many reflex phenomena. In treating a case of this type, a sharp purgative may be given every morning (e.g. pulv. scam. co., grs. v), and salt and water or an infusion of quassia used as an injection. Sometimes this is ineffective, and it is possible that the cæcum or even the appendix is the main site of lodgment of the worms. Santonin may then be necessary in order to clear the intestinal canal.

The *Bilharzia hæmatobia* is occasionally found in the rectum as well as in the urinary passages. It gives rise to papillomatous polypi, within which the ova can be readily demonstrated, these are rounded or oval bodies, differing from those found in the urine in that they possess a lateral spine-like projection whilst in the latter it is terminal. Considerable tenesmus, diarrhoea and discharge of blood are present, and the hæmorrhage may become so abundant as to destroy the patient's life, especially when urinary symptoms are co-existent. This condition is found in some portions of Egypt, where it is very common, and in other tropical regions. The living ova can be destroyed by intravenous injections of tartar emetic, but the papillomata persist, and need to be dealt with by operation. Removal of isolated masses by injection with pure carbolic acid or even by diathermy, is usually of little value, the only successful measure for extensive disease has been found to be excision of the affected mucous membrane.

Rectal and Peri-rectal Suppuration is not uncommon, and is very liable to lead to the formation of fistulæ. It may be due to the impaction of foreign bodies, the extension of ulcerative processes, or the suppuration of piles. Occasionally the trouble starts in the skin around the anus and sometimes the pus reaches the peri-rectal tissues from other viscera e.g. the neck of the bladder, prostate, etc., or from above, in connection with spinal or pelvic abscesses. Not unfrequently the abscess is attributed to injury or to cold, as from sitting on a damp stone or a draughty closet, but probably these are merely the final exciting agents.

1. An **Anal Abscess** forms immediately under the anal integument, and superficial to the external sphincter (Fig. 814, 4), it is usually due to inflammation of one of the numerous sebaceous follicles in that locality. It may be acute or chronic, and is one of the most frequent causes of fistula in ano. It must be freely opened throughout its whole length and packed.

2. A **Submucous Abscess** (Fig. 814, 2) usually results from a suppurating internal pile. The pus spreads up and down under the mucous membrane, and gives rise to a blind internal fistula (Fig. 816, 4). It is generally confined to one side of the bowel, and causes

great pain on defaecation. Digital examination is extremely painful. Treatment consists in draining it at the most dependent spot close to the anus but it is often necessary to slit up the undermined mucous membrane.

3 **Acute Ischio-rectal Abscess** is due to infection of the loose fatty tissue filling the ischio rectal fossa (Fig 814 1) the organisms reaching it either through the perineum or from the bowel. The *B coli* is usually present and in consequence the pus has the ordinary characteristic offensive odour. A red painful swelling is noticed on one side of the anus which is at first hard and brawny but soon becomes soft and fluctuating. Defaecation is exceedingly painful as also digital exploration of the bowel and the patient is unable to sit with any comfort. If left to itself it may burst internally or externally.

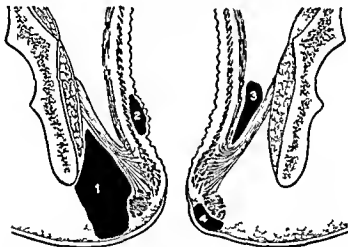


FIG 814—DIAGRAMMATIC SECTION OF ABSCESSES SITUATED NEAR THE LOWER END OF THE RECTUM

- 1 Ischio-rectal abscess 2 submucous abscess 3 pelvi-rectal abscess
4 anal abscess

or in both directions and a fistula in ano is very liable to follow. An abscess in one ischio-rectal fossa may spread across behind the anus to involve the other side and the fistulous opening which is often present in these cases is usually found in the mid line posteriorly between the internal and external sphincters.

Treatment—Any abscess in this region should be opened at once since any delay increases the risk of a fistula. Under efficient anaesthesia a cruciate or T shaped incision is made and the flaps cut away to allow adequate drainage (Fig 815). If the abscess has extended to the other ischio-rectal fossa both sides and the communicating tract should be laid open. If a fistula is present it should be dealt with at a later stage.

In the after treatment moist dressings, irrigations and baths should

be employed. It is essential that all wounds in this region should heal from the deepest part. Gauze may be lightly introduced to the bottom of the wound but tight packing delays healing and prevents free drainage.

4 **Chronic Ischio-rectal Abscess** is usually met with in run-down or tuberculous individuals during young adult life and is not unfrequently a complication of phthisis. A deposit of tuberculous material replaces the fat ordinarily occupying the ischio rectal fossa and this after a time undergoes caseation or forms an abscess which gradually spreads without pain or other inflammatory disturbance and may extend very widely. After it has burst the orifices of sinuses may be found at a considerable distance from the anus. Clinically, an indurated and painless mass forms in the fossa and slowly spreads softens and is transformed into a more or less extensive abscess sac this is associated with some general asthenia slight pyrexia and a certain degree of localized pain. Operative Treatment is desirable in most of these cases and if possible before suppuration has occurred incision removal by a sharp spoon of all tuberculous tissue and dressing the wound with gauze infiltrated with iodoform are the essential elements. Where extensive sinuses or fistulae exist treatment as for fistula in ano may be required but it is wise not to attempt too much if serious pulmonary mischief is present. Treatment of the sanatorium type must of course be instituted in all cases.



FIG 815 — SITUATION OF T SHAPED INCISION REQUIRED FOR OPENING AN ISCHIO RECTAL ABSCESS

5 **The Pelvi-rectal Abscess** (Fig 814 3) consists in a localized collection of pus in the loose cellular tissue above the levator ani between it and the rectum. It may be secondary to rectal lesions such as penetration of the wall above the internal sphincter or extension of ulceration from a carcinoma but not uncommonly it is caused by pelvic cellulitis or suppuration in the mesorectum prostate etc. The ordinary phenomena of a deep abscess are produced and the pus may burrow downwards through the levator ani to the ischio rectal fossa or may travel up and involve the pelvic peritoneum. Sometimes it extends around the bowel causing one type of horseshoe fistula. Other collections of pus may find their way into this region from different parts e.g. a psoas abscess from spinal disease appendix abscesses etc. Rectal examination indicates the existence of a painful swelling high up in the bowel. As soon as a diagnosis is made the abscess should be freely laid open and drained and if possible by an incision behind the anus. Of course an abscess which is secondary to a tuberculous spine is an exception to this rule.

6 Occasionally a *diffuse* form of cellulitis involves the peri rectal connective tissue not uncommonly resulting in gangrene (*gangrenous periproctitis*). It is most likely to be seen in weakly individuals and asthenic old people. The suppuration may extend above the levator ani and lead to deep fistulous tracks. The parts must be freely opened up and the gangrenous tissue scraped away and the raw surfaces treated with peroxide of hydrogen. The wounds are then packed with iodoform gauze and subsequently well irrigated twice a day. Free stimulation is always required in these cases but the prognosis is very bad.

Fistula in Ano—This term is somewhat loosely applied to all conditions in which suppurating tracks are found in the neighbourhood

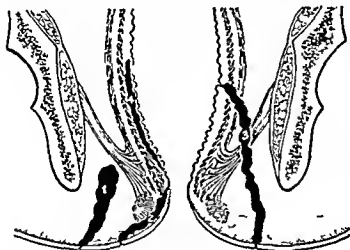


FIG 816—DIAGRAMMATIC REPRESENTATION OF VARIOUS FORMS OF FISTULA IN ANO

- 1 Blind external fistula 2 superficial fistula resulting from an anal abscess
3 complete fistula opening above the internal sphincter and traversing the levator ani 4 blind internal fistula

of the anus and the lower end of the rectum. Many of these are merely sinuses which have but one opening. *Fistulae* are usually due to rectal or peri rectal suppuration but sometimes result from the ulceration of a simple syphilitic, malignant stricture of the gut the inner opening being either above in the substance of or below the stricture this is more likely to be the case when the *fistulae* are multiple.

Varieties—1 The *Complete Fistula* is one in which there are openings both externally and into the bowel. When following an anal abscess they are both close to the anus and the track lies immediately beneath the skin and mucous membrane (Fig 816 2). When following an acute ischio-rectal abscess the external opening is a variable distance from the anus and the inner not more than 1 inch up the

bowel, being situated in relation with the so called internal sphincter occasionally blind submucous or subcutaneous extensions are met with branching off from this, but not so frequently as when the fistula follows a chronic tuberculous abscess. In the latter case the skin may be extensively undermined looking blue and congested, and the fistulous tracks may burrow widely opening even on the thigh or in the perineum or buttock. The so called *horseshoe fistula* passes round the bowel, usually behind the anus, either superficial to the external sphincter or beneath it and opens also on the other side. Moreover, the mucous membrane of the bowel is often undermined, and stripped from the muscular coat for some distance above the internal opening by sinuses or an abscess cavity. Occasionally the complete fistula which follows an ischio rectal or pelvi rectal abscess opens some way up the bowel as well as externally, and traverses the levator ani (Fig 816 3), constituting a much deeper and more serious lesion.

In any of these conditions secondary tracks may form, burrowing in all directions, and sometimes the opening up of these passages is a serious matter. Thus they may run forwards to the scrotum, or outwards into the gluteal region.

2 A *Blind External Fistula* (Fig 816 1) results from the opening of an ischio rectal abscess in which no communication with the bowel is present. A probe passed into the wound can often be felt by a finger in the rectum with only the thickness of the mucous membrane between.

3 A *Blind Internal Fistula* (Fig 816, 4) is in reality a sinus opening into the bowel just above the anus. Attention is usually drawn to the condition by the passage of pus with the motions or independently, and perhaps by preceding inflammatory disturbance. The orifice can sometimes be felt by digital exploration, on the insertion of a speculum it may perhaps be seen, and can be examined by a straight probe or one bent in the form of a hook, it is often associated with considerable undermining of the mucous membrane, and if chronic with stenosis of the bowel.

In all these conditions it is difficult to obtain healing, owing to the introduction of septic material from the bowel, and to the state of unrest in which the parts are kept by the continuous movements, voluntary and involuntary, of the sphincters.

Operation.—The bowels must be completely emptied, both by means of castor oil or some suitable purgative, and about an hour previous to operation by enema, a most important preliminary, not only for the comfort of the operator, but also because no further action is desired for some days. The patient is placed in the lithotomy position, and the perineal and anal regions shaved and purified. Methylene blue injected into the fistula stains its walls and renders them easily visible to the operator. If a finger be placed over the internal orifice while the injection is being made, the blue will follow all ramifying tracts, and these may then be easily followed or opened and excised. A probe is passed along the fistula into the rectum, and guided by it a grooved director, along which a curved pointed bistoury is introduced, and the intervening structures divided. In a superficial

fistula both sphincters may escape injury and in a deep one both may be involved but in the majority of cases some fibres of the external sphincter are divided. A careful search is made for pockets or tributary branches of the main tract and these if found are opened up and curetted undermined and unhealthy skin being snipped away with scissors it is important however to remember that the sphincter ought never to be divided in more than one place. Bleeding points are if necessary tied and the cavity is carefully dusted with iodoform and lightly packed with gauze soaked in iodoform and glycerine. Pressure by a graduated compress of sterilized wool should be applied by means of a T bandage.

When a sinus extends for some distance under the mucous membrane from the upper end of the original fistula it may not be always desirable to lay it open to its whole extent since this may involve serious hæmorrhage at a spot where it cannot well be checked. It will often suffice partly to divide it and then if the main fistula has been satisfactorily dealt with it will probably heal without difficulty.

In the case of a horseshoe fistula the sphincter need only be divided at one spot and that usually in the middle of the horseshoe. The whole tract must however be opened up loose tags of skin removed by the scissors and an ordinary dressing applied.

A small superficial fistula not extending beyond the anal margin can sometimes be completely excised and the wound closed by sutures thereby securing healing by primary union. In these operations two essentials must be borne in mind. Firstly that part of the wound involving the anal canal should be encouraged to heal before the more superficial part and in order to ensure this sufficient skin should be excised. The wound should be triangular the apex involving the anus. Secondly the retention of sphincteric control. If the internal sphincter is divided incontinence will certainly result but provided this is retained the external sphincter may safely be divided. When this is necessary it may be done in two stages. At the first stage the superficial part of the wound is laid open and a silk ligature is passed through the deep part of the fistula into the rectum and tied loosely round the external sphincter. One to two weeks later the muscle is divided. This two-stage method helps to fix the muscle and when it is divided less retraction takes place.

After-Treatment—The bowels should if possible be prevented from acting for three or four days and most scrupulous care taken to keep the parts clean. The deep dressing need not be changed for the first twenty-four or forty-eight hours provided that the surrounding skin is well cleansed. When the plugs are removed fresh strips of gauze soaked in iodoform and glycerine are introduced night and morning after the wound has been irrigated. On the fourth day castor oil is administered and subsequently an action of the bowels must be secured daily. The wound is allowed to granulate and care taken that irregular healing does not lead to a re-formation of the fistula. With this object in view it may be advisable to pass a moderate-sized bougie from time to time.

The presence of tuberculous disease locally and in the lungs must

be carefully considered and taken into consideration in advising operation. If the pulmonary trouble is early there is no necessity for delaying operation, the patient will derive much more benefit from sanatorium treatment if his fistula has been put on the way to recovery. In the later stages however, it may be advisable to leave the fistula alone, or only to relieve urgent symptoms.

Fissure of the Anus.—This painful complaint consists of a small crack or ulcer at the anal margin. Usually single and posterior, occasionally anterior it may sometimes be due to injury or the irritation of a polyp, but is more often caused by stretching of the anus by hard faeces. It was formerly believed to be due to a torn semilunar valve, but in the majority of cases it is a crack starting at that point of the anus which has the least muscular support. Owing to the posterior decussation of some of the superficial fibres of the external sphincter the mucous membrane here does not receive the same support as laterally. Anterior fissure is more common in women, since the perineal body is not so strong as in the male and may be damaged. Fissure is occasionally syphilitic or tuberculous.

The skin at the lower end of a fissure becomes oedematous and forms a tag 'the sentinel pile'. In the chronic fissure the edges become hard, indurated, and muscle fibres may be seen in the base.

The Symptoms of this condition are very distressing, consisting of burning pain during and after defaecation, which often lasts for hours. The pain is usually associated with tenesmus, and may radiate down the thighs or up the back, and not uncommonly to the left sacro iliac joint, it may be so severe as to lead the patient to refrain from defaecation for prolonged periods. The faeces may be streaked with blood or pus. On examining the part, the sphincter is found to be contracted spasmodically, and the entrance of a finger is forcibly resisted.

Treatment in the earlier stages is undertaken by regulating the action of the bowels by suitable lavatives, by the use of cocaine suppositories prior to defaecation and by improving the general health. Sometimes the application of a hamamelis ointment, combined with the ung. hydrargyri nitratis dil., is most effective in giving relief. 5 c.c. of an oil soluble local anaesthetic solution such as A.B.A. or proctocaine may be injected into the tissues around and behind the sphincter. The anaesthesia produced and the relief of spasm may be sufficient in an early case to start healing. Local applications of ichthyol may also be made.

Operation should be performed if the fissure is chronic, with indurated edges and muscle fibres exposed in the base, if there is a small polyp at the upper end and a large tag at the base, or if internal piles or a fistula are present. Operation consists in the excision of the fissure, together with any tag or polyp. The area of skin excised should be triangular, the apex at the anus and the base 1 to 2 inches away. The superficial fibres of the external sphincter are divided. An alternative method consists in incising the fissure throughout its length the incision dividing the muscle and being prolonged on to the skin behind the fissure. The edges are then snipped away to leave a triangular wound.

Pruritus Ani is a condition characterized by intense and incessant itching of the anus and its surrounding skin. At first noticed mainly at night and interfering with sleep it may in time persist both day and night interfering with the patient's work and wearing him out through want of sleep. Scratching becomes a necessity and yet aggravates the condition. It may be due to parasites such as thread worms or to some ulcerative condition of the anal canal just at the muco-cutaneous junction or it may rise from some neurosis. The skin looks red and excoriated and is usually swollen and thrown into oedematous folds radiating from the anus.

Treatment—Parasites must be destroyed and ulcers of the anal canal carefully looked for and cauterized. For cases which persist in spite of such measures Sir Charles Ball devised an operation which has proved of value and consists in dividing the terminations of all the sensory nerves to the part. Two semi-elliptical incisions are made around the anus leaving a narrow pedicle in front and behind the wounds are deepened to expose the sphincter and the flaps raised from the muscle inwards around the anal margin and up to the muco-cutaneous junction. The pedicles in front and behind are undercut and the outer margins of the incisions also to an extent corresponding to the area of irritation the flaps are then replaced and sutured. The immediate result of such an operation is complete anæsthesia of the anus. Normal sensation returns after a time but without pruritus.

Hæmorrhoids or Piles consist in a varicose condition of the veins surrounding the anus and lower inch or two of the rectum.

The character of the blood supply of this portion of the bowel and the conditions under which it is carried on go far to explain the frequency of this affection. The circulation in the pelvic colon is similar to that in the intestine generally the vessels being distributed transversely around the gut but in the rectum they run in longitudinal series along the bowel being connected by transverse branches which form a plexus around and just above the anus. Their situation in the loose submucous tissue where there is but little support necessarily exposes them to great and sudden variations of pressure before and after defæcation. Their dependent position at the lowest part of the portal area together with the absence of valves and the fact that they constitute an important communication between the portal and general systems and thus afford the chief means of escape from a block on the portal trunk—all these reasons may be looked on as **Predisposing Causes** of the condition. In addition to these we must also mention a sedentary occupation alcoholic excess and chronic constipation which by leading to congestion of the liver are frequent precursors of piles. They are exceedingly common in young people especially in men about twenty years of age forced to lead a sedentary life up to middle age the tendency diminishes but in elderly individuals many conditions e.g. an enlarged prostate favour their development. Simple stricture of the rectum or malignant disease may also interfere with the return of blood so as to lead to piles. Young women are remarkably exempt owing probably to the regularity of the menstrual

discharge, but uterine conditions, such as pregnancy, displacements, or tumours, are liable to be associated with them.

A varicose condition of the veins in the neighbourhood of the anus is often present without being recognized by the individual, but many different circumstances may bring the symptoms into prominence by causing an attack of thrombosis, such as the use of drastic purgatives, especially aloes, local exposure to damp and cold, as by sitting on a cold wet stone or in a draughty closet, or sudden congestion of the liver, as by alcoholic excess, or a chill.

Two chief varieties of piles are described, *viz* the external and internal, but frequently a combination of the two conditions is present.

External Piles are found at the margin of the anus, and are covered with skin. They consist of a small central vein in a varicose state, surrounded by a development of subcutaneous fibro-cellular tissue, which latter is much more abundant than the vascular element, in fact, they practically consist of longitudinal folds of skin of a dark brown colour radiating from the anus, and superficial to the sphincter. In the absence of thrombosis they give rise to no symptoms beyond a little pruritus, and perhaps some irritation immediately before and after defecation. A 'thrombosed external pile' is a common condition. A tense rounded swelling develops at the anal margin. This may be caused by thrombosis in a varicose vein or the rupture of a small vein and thrombosis of the extravasated clot—a 'peri-anal hæmatoma'—produced by some traumatism or sudden strain thrown on the peri-anal vein by coughing or sneezing. Inflammation occurs readily, and is exceedingly painful. In the absence of surgical treatment the condition may subside, leaving a fleshy fold of skin or tag, due to the organization of the thrombus, or the hæmatoma may burst, or supuration may ensue forming a small abscess which may lead to a fistula.

Treatment.—External piles if giving rise to symptoms, should be removed by snipping them off with scissors under local anaesthesia. When thrombosis is present the patient may be put to bed, and hot fomentations, baths or lead lotion compresses applied to ease the pain. A quicker result will be obtained by incising the hæmatoma, turning out the clot and cutting away the edges to leave a flat wound.

Internal Piles consist of dilated veins held together by a certain amount of connective tissue, and covered by mucous membrane. At first they are quite soft and compressible, and easily emptied on pressure, but when they have existed for some time the connective tissue may be increased in amount, and arterial twigs are often found running into the mass.

The condition is limited to the lower inch or two of the bowel, and may present very varied appearances in different cases. Thus, there may be a general dilatation of the veins in the submucous tissue without the formation of any distinct tumours. The mucous membrane is then of a deep claret colour, somewhat thickened, and liable to protrude during defecation. There is a certain amount of glary mucous discharge, and the faeces may be streaked with blood, but, as a rule, the hæmorrhage is not great. Such a condition is usually

followed by a definite formation of hamorrhoidal tumours, and not unfrequently runs on to prolapse.

When distinct hamorrhoidal masses form, they may be of two types (a) The *longitudinal or fleshy pile*, consisting of broad sessile masses dusky in colour, soft and compressible in consistency, and covered by mucous membrane, which, although thin and stretched, still remains smooth and shiny, like the skin of a black grape (Fig 817). Between the piles depressions are found in which small portions of faeces may lodge and produce irritation. This form generally bleeds but little. (b) The *globular or bleeding pile* is single or multiple, and as a rule somewhat pedunculated, the surface of the tumour is roughened and granular, like a strawberry, due to the existence of dilated capillaries. When, however, a portion of it has been repeatedly protruded,

the exposed mucous membrane becomes hard, and practically converted into skin, and the columnar epithelium may be replaced by the squamous type. The hamorrhage may be abundant, and comes either from the dilated superficial capillaries, or occasionally from a central arterial twig.

The Symptoms of internal piles are often not very marked until hamorrhage occurs, but there is usually a sense of weight or fulness about the anus, with sometimes pain, which is increased before and after defecation. The patient feels as if a

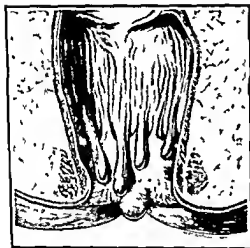


FIG 817.—DIAGRAM OF LOWER END OF THE RECTUM AND ANAL CANAL SHOWING INTERNAL PILES AND ONE EXTERNAL PILE

foreign body were present and the mass not unfrequently protrudes, giving rise to pain and inconvenience owing to the grip of the sphincter they can however, be easily replaced by the patient. Sooner or later hamorrhage is almost certain to occur, coming on at first after defecation and only a few drops being lost. After a time however the flow increases, and may continue to such an extent as to cause marked anaemia. If the case remains untreated, the pain and inconvenience increase, a blood stained mucous discharge from the rectum is noticed, reflex irritation of neighbouring organs is produced, and a condition of nerve prostration from pain and hamorrhage may result. Where the piles are due to portal obstruction, as in cirrhosis of the liver, the bleeding may be beneficial, and must not always be checked.

Complications of Piles.—*Thrombosis* of the venous ampullæ leads to what is popularly termed an 'attack of piles', this is less common with the internal than the external variety and the fleshy form is that usually affected. A painful distension and swelling of the pile occurs, which becomes blue in colour and exquisitely sensitive. It may subside with or without suppuration, in the latter case a spontaneous cure may result, but in the former the abscess may burst into the bowel or may burrow extensively and even give rise to suppurative pyelphlebitis or pyæmia. *Strangulation* of the piles by the sphincter ani may follow protrusion where reposition is not effected the mass becoming painful, tense, swollen, and livid in colour, inflammation running on to ulceration and sloughing follows, and a spontaneous cure may be effected.

The **Diagnosis** of piles from other swellings which occur in the neighbourhood is not difficult. From *prolapse* piles are recognized by their irregularity, the swelling not being of a rounded smooth, annular variety, as in the former case, the two conditions are however, often associated. From *polypus* piles are distinguished by being multiple rather than single, by being softer and more compressible by their situation close to the anus, by the absence of a pedicle, and by the hæmorrhage being usually more marked. *Mucous tubercles* and *condylomata* may be mistaken for external piles, but are recognized by their general wart like appearance, by their symmetry, owing to infection of one lip of the gluteal fold from the other, and by their situation at a little distance from the anus. The consistency, appearance, and history of an *epithelioma* should effectually prevent any error in diagnosis.

It is important also to remember that blood may be passed *per anum* from many other conditions besides piles. In the latter case the blood is of a bright red, florid colour, and often coats the fæces, whereas if it originates higher in the intestinal canal it is dark or tarry in colour (*melana*) and is more intimately mixed with the excreta. A visual and digital examination of the rectum should always be made in order to ascertain the exact cause of the bleeding.

The **Treatment** of internal piles is both general and local.

General Treatment consists in removing all possible sources of venous congestion, in regulating the bowels, and assisting the functions of the liver. Mild aperients such as the confections of senna and sulphur, or castor oil are better than more drastic drugs, and aloes should generally be avoided. At the same time the food is regulated, alcohol forbidden, and suitable exercise enjoined. When dependent on the pressure of a gravid uterus, little can be done beyond attending to the regular action of the bowels until the child is born.

Local Treatment in the earlier stages consists merely in *palliative* measures. The parts must be protected from injury, and only soft paper or cotton wool used after defæcation, when protruding, the piles should be sponged with cold water and gently returned. An ointment containing an extract of witch hazel (*hamamelis*) or the injection of hazeline lotion (r in 8), is also advisable, and bleeding

from piles can often be arrested by this means, or by the application of the *ung. gallæ c. opio* (B.P.)

When there is much pain or bleeding, Operative Treatment is necessary. Care must be taken before advising it to ascertain that no other serious disease of the rectum such as cancer, is present, and that the piles are not dependent on such local conditions as enlargement of the prostate, or uterine fibroids, or on hepatic or cardiac disease, when an operation might be injudicious and harmful. In all cases the bowels are thoroughly emptied by a dose of castor oil given the night before and an enema on the morning of the operation, whilst the patient sits over hot water for half an hour beforehand. The lithotomy position is adopted, the perineum is shaved and cleansed, and the surgeon stretches the sphincter by introducing the two index fingers and separating them forcibly, by this means bringing into view

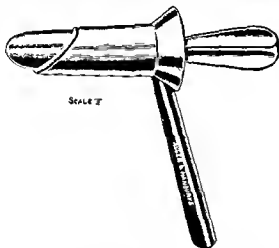


FIG 818.—PROCTOSCOPE USED WHEN INJECTING PILES

the whole of the diseased area of mucous membrane, which never extends beyond 2 inches from the anus. The following plans of treatment are those chiefly employed.

1 *Injection*—The aim of this treatment is thrombosis. It is only suitable for internal hæmorrhoids, and can be carried out without an anæsthetic. A short proctoscope which is bevelled (Fig 818) is inserted so that the pile comes into view. A special syringe carrying a long fine hypodermic needle is used, 2 or 3 c.c. of a 1 in 5 carbolic oil are injected near the base of the pile (Fig 819), which is seen to turn white if the injection material has been rightly placed. A second injection may be necessary after a week. In carefully selected cases this method is very successful and its economic advantages are obvious.

2 *Operation*—Although a number of different operations have been used in the treatment of piles, only one will be described, *ligature*

and excision. This operation is simple and is in general use. A purge is given thirty six hours before and an enema saponis the evening before operation. A rectal wash out with water may be given a few hours before the operation. The skin around the anus is shaved. While various forms of anæsthesia may be used a low spinal anæsthetic possesses the great advantage of giving perfect relaxation of the anus which otherwise requires a deep degree of general anæsthesia.

Operation—The sphincter is first stretched by the surgeon and the rectum swabbed out with a solution of lysol dettol etc. The internal hæmorrhoids are then picked up with forceps. Owing to the terminal distribution of the branches of the superior hæmorrhoidal artery there are usually three main piles one anterior and two postero lateral. With the pile slightly pulled down an incision with scissors is made at the muco cutaneous junction or slightly further out if an external tag is also to be removed. The pile is transixed ligatured with stout catgut or silk at the level of the anus and cut away leaving sufficient

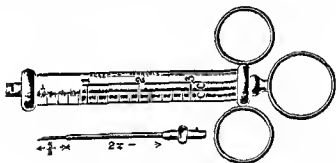


FIG. 819.—A USEFUL SYRINGE USED FOR INJECTING INTERNAL HÆMORRHOIDS

tissue to enable the ligature to have a good grasp. A vaselined flatus tube is then inserted and the wound dressed with eusol gauze.

Careful after treatment is required. Morphia should be given to relieve pain. The anal region is irrigated twice daily and the bowels confined for three days. After the first motion the patient is allowed to go to the bath. A finger should be passed on the tenth day and thereafter at intervals in order to avoid any tendency to stenosis. This complication is usually caused by excessive stripping up of the pile before it is transixed and ligatured.

Post operative retention of urine is a common inconvenience after operations in this region. A small piece of ice inserted in the anus will often relieve it.

Rectal Prolapse—A certain tendency to eversion of the mucous membrane of the bowel is a constant accompaniment of the act of defæcation sometimes however this persists after the evacuation of the bowels is concluded constituting a condition of prolapse. At first only the mucous membrane is protruded constituting an *incomplete* prolapse (Fig. 820) if however the whole thickness of the bowel mucous membrane submucosa and even the muscular and

serous coats is involved it gives rise to the complete variety (Fig 821) The former condition (sometimes badly termed a prolapsus ani) is more commonly met with in adults and the latter (the so-called prolapsus

recti) in children but it must be understood that the latter is always preceded by an incomplete stage limited to the mucous membrane and that in adults complete prolapse is occasionally observed.

Causes—(1) Laxity of the sphincter may occur in weakly individuals and those who have been much exposed to the debilitating effects of residence in tropical climates especially when chronic constipation or diarrhoea has caused the evacuation of the bowels

to be accompanied by straining. In children the malnutrition following measles and whooping-cough may predispose whilst the loss of fat from the perirectal cellular tissue may assist. (2) Conditions which have led to chronic tenesmus or violent expulsive efforts e.g. piles, chronic constipation, diarrhoea, rectal irritation as from polypus or worms in children or diseases of neighbouring organs such as vesical calculus, stricture or enlarged prostate may also determine prolapse.

Symptoms and Diagnosis—The anal orifice is occupied by a smooth rounded swelling red or purplish in colour covered by mucous membrane this protrusion in the early stages can be easily replaced but returns when the patient coughs or strains. When the swelling is of large size reduction is increasingly difficult and painful from infiltration and fibrous overgrowth of the submucosa and the exposed mucous membrane is very liable to become inflamed and ulcerated. When the whole thickness of the gut is protruded the serous lining may accompany the tumour but this is usually limited to the anterior surface and into

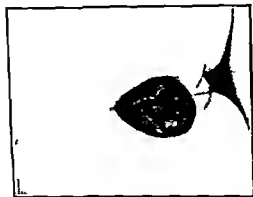


FIG 820.—PHOTOGRAPH OF PATIENT WITH PROLAPSE OF THE RECTUM
The patient is lying on her side.

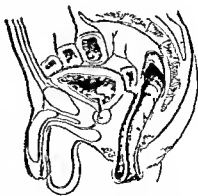


FIG 821.—LONGITUDINAL SECTION OF COMPLETE PROLAPUS RECTI

the sac thus formed small intestine or omentum may pass, and even become strangulated. The prolapse itself may also be constricted if allowed to remain for long unreduced, the mass is then livid, swollen, and intensely painful and if left to itself may slough and thus lead to a spontaneous cure, although severe septic symptoms may supervene, and even perforative peritonitis.

There should be but little difficulty in recognizing a prolapse, the only condition for which it can be mistaken is an intussusception protruding from the anus, in this however, the finger or a probe can be inserted into the rectum by the side of the protruding gut, which is impossible with a prolapse.

Treatment—In the earlier stages, all that is needed is the removal, if possible, of the cause of the tenesmus, *e.g.* dilatation of a urethral stricture, removal of a vesical calculus, or the regulation of the bowels so as to check either chronic diarrhoea or constipation. When piles are present, they should be treated as described above, and the prolapse will, as a rule, subsequently disappear. Thread worms must be dealt with by suitable means (*q.v.*). Beyond this, cold or astringent injections may be employed, *e.g.* sulphate of iron (1 to 3 grains to 1 ounce), and it is advisable for the individual to acquire the habit of having the daily motion at bedtime, whilst children are made to defæcate lying on the side, one buttock being pulled up for the purpose. The prolapse is carefully washed, reduced by pressure with the fingers, and retained by strapping the nates together, particularly in children, or by applying some suitable pad and a T-bandage. Electric treatment to tone up the sphincter and levatores ani may be of assistance, and in children palliative treatment of this type is usually successful.

In some cases light cauterization of the mucous membrane has been advocated. This produces adhesions between the mucous membrane and the muscle coats.

In adults, however, **Operative Treatment** has frequently to be undertaken.

In the slighter cases of incomplete prolapse, it will suffice to diminish the size of the anal orifice by snipping away radiating folds of skin and mucous membrane including any piles that may be present. In worse cases it may be advisable to remove a wedge of the posterior wall of the prolapse, including a portion of the sphincter, the edges being brought together by deep stitches. Where this has failed, or is thought insufficient, the prolapse has often been completely removed, but the ultimate results are usually so disappointing that operations of this type should be entirely discarded.

The most reasonable proceedings are those directed towards fixation of the rectum (*rectopexy*) either backwards to the posterior pelvic wall or from above. Various operations of this type have been described, but the simplest, and probably the best, consists in opening up the post-rectal space through a transverse incision placed midway between the anal margin and the tip of the coccyx. The external sphincter is detached from the bone, and the post-rectal space is then easily reached and the bowel pushed forwards. The wound is packed with gauze, which is only removed gradually so as to ensure healing by granulation.

Before the operations are performed and certainly in the milder cases high submucous rectal injections of 5 per cent carbolic oil may be tried in an attempt to fix the mucous membrane. This may be allied with sphincteric exercises or plastic operations to tighten the external sphincter.

Tuberculous Disease of the Rectum occurs in the form of ulcers which are usually multiple and perhaps very extensive. Infection may be due to the swallowing of infected sputum but is more probably of hæmatogenous origin. It starts in the submucosa and the ulcers which follow have the usual features with undermined edges and prominent granulations. There is usually a marked tendency to the production of fistulæ by extension of the process outwards. The symptoms are those of rectal irritability, pain on defæcation and discharge of muco-pus and perhaps blood. **General Treatment** of the sanatorium type is necessary and locally the bowel is emptied and cleansed by irrigation. In the worst cases colostomy may be required in order to put the bowel at rest.

Syphilitic Disease of the Rectum and Anus—The rectum and anus are attacked by syphilitic disease in a variety of ways the most prominent being as follows:

(a) The initial lesion of primary chancre is occasionally met with in the neighbourhood of the anus.

(b) In the secondary stage mucous tubercles or condylomata are frequently seen being placed either at the anal margin or symmetrically on either side of the gluteal fold the sores on one side having evidently infected the other. They are of the usual type and are treated by dusting with powdered calomel and keeping a piece of dressing between the lips of the fold.

(c) Tertiary syphilitic lesions of the rectum and anus are occasionally found but at the present time are undoubtedly uncommon. Gummatous infiltration of the rectal mucosa may be followed by ulceration and cases have occurred in which the rectum, vagina and external genitalia have all been involved. Stenosis following syphilis may result in a rectal stricture.

Gummata in this region particularly with ulceration are likely to be mistaken for malignant disease. They are stated to be multiple rather than single and the history, presence of a positive Wassermann reaction and the result of a biopsy should enable the diagnosis to be made.

Treatment—The usual treatment for syphilis should be adopted with due attention to any tendency towards stricture formation. In severe cases colostomy may be required.

Fibrous Stricture of the Rectum is usually met with in women over forty years of age and is most often situated 2 or 3 inches from the anus or as high as its junction with the sigmoid flexure. In this position it is generally due to the cicatrization and contraction of ulcers following prolonged diarrhœa and dysentery although occasionally it follows tuberculous or syphilitic disease. Any form of chronic proctitis e.g. gonorrhœa may also lead to it. It occurs sometimes as a sequela of pelvic cellulitis and suppuration from the contraction

of fibrous bands which may bind the rectum backwards to the sacral wall or may merely constrict it. Repeated attacks of inflamed piles may also lead to stenosis at or just above the anus. A stricture sometimes results from traumatism or follows operations involving the whole or at any rate the greater portion of the circumference of the bowel. As already mentioned it may be associated with a fistula especially if the latter has existed for long and is then due to a chronic inflammatory fibrosis lighted up by the persistent irritation of the bowel. The inner opening is then found in the substance of the stricture. The use of radium in the treatment of anal and cervical carcinoma occasionally produces an anal or rectal stricture. Lymphogranuloma inguinale a rare venereal disease believed to be due to a filter passing virus with a predilection for the lymphatic system may in women produce a rectal stricture by the fibrosis which follows the involvement of the pelvic lymph spaces around the rectum. Pressure of the foetal head in prolonged labour is another possible cause. Lastly a congenital stricture may result from the persistence of part of the proctodeal membrane.

The earliest symptoms of stricture are often alternating attacks of diarrhoea and constipation in which of course the constipation is primary and the diarrhoea due to a catarrhal enteritis arising from the irritation of the retained faeces. Gradually the difficulty in passing motions becomes more and more marked until no relief is obtained apart from medicine. The faeces themselves become narrowed flattened and elongated something like pipe-stems or small masses like shrimps may alone succeed in passing. This is associated with pain and uneasiness referred to the lower bowel a certain amount of blood and mucus may be mixed with the excreta and sooner or later marked dyspepsia and abdominal distension supervene. In untreated cases obstruction may result and lead to a fatal issue or the mucous membrane of the bowel above the stricture becomes ulcerated an abscess forms and subsequently a fistula through which a certain small amount of faecal material passes. If several of these fistulae are established the patient may finally succumb to chronic septic poisoning and exhaustion.

An examination of the bowel with the finger may reveal a smooth regular constriction of the gut as if a band had been tied round it the fibrous mass and the aperture in it feeling something like an os uteri. In other cases the bowel is stenosed for some distance and its surface more or less ulcerated whilst if due to pelvic cellulitis it may be drawn up and fixed to the posterior pelvic wall. The gut above the contraction is hypertrophied and distended whilst if filled with retained faeces the mucous membrane may show signs of inflammation or even stercoral ulcers. The gut below the stricture is usually dilated (ballooned) partly from paralysis of its wall and partly by invagination of the mass from above.

The Treatment in the early stages consists in keeping the bowels regular and the motions soft by means of paraffin and laxatives or by enemata. The diet is regulated so that there is no unnecessary debris. Locally the stricture if within reach should be dilated by means of bougies passed in increasing sizes every two or three days.

the utmost gentleness must be used in order to stretch the mucous membrane and not tear it. When situated low down the stricture may be notched posteriorly or slightly nicked in several places with a blunt-ended bistoury and bougies then passed. As these strictures always tend to contract again treatment is usually prolonged.

Colostomy will be required if ulceration and fistulae are present or if the stricture is high and dilatation involves much risk.

Tumours of the Rectum—**Polypus Recti** occurs most frequently in children and consists usually of an adenoma of Lieberkuhn's follicles but occasionally of simple fibrous tissue covered with mucous membrane. They are commonly found within easy reach of the anus and present an appearance something like a small cherry with a long pedicle pendulous and freely mobile. The symptoms caused are irritability of the bowel and the passage of blood by the anus which latter when occurring in a child without symptoms of obstruction is almost pathognomonic of polypus. It is sometimes associated with a fissure of the anus and possibly with a pile. A natural cure can be effected by rupture of the attenuated pedicle which is at first attended by a certain amount of hæmorrhage. **Treatment**—The polypus is cut away after tying or twisting its pedicle.

Polyposis Intestini or Multiple Adenomatosis.—This is a rare disease in which the colon and rectum are thickly studded with polypoid growths (Fig 822). The disease occurs more commonly in men than in women and between the ages of ten and forty. There is ample proof that polyposis intestini is an inheritable disease and Dukes has published charts and thirteen family pedigrees which are most convincing on this point*. The disease is transmitted by both males and females and the inheritance can be traced through several generations. The tragedy of these cases is that they develop cancer of the rectum or colon usually in the early thirties or forties. The only form of radical

FIG 822 SPECIMEN SHOWING MULTIPLE POLYPI OF THE COLON (MR NORBURY'S CASE)

treatment which offers any prospect of cure is colectomy.

* Dukes Cuthbert *The Cancer Review* 1930 vol v No 4 pp 241-256

Papilloma of the rectum is a rare disease, and gives rise to hæmorrhage from irritability of the bowel or if large, even to obstruction. This condition is not always limited to the rectum, but may extend through the greater portion of the intestine, and then proves fatal from hæmorrhage. In some cases it may be associated with a growth higher up in the bowel (Fig 823). Treatment consists in removal by ligature or wire snare, where practicable.

Sarcoma is another uncommon disease in the rectum. It occurs in the shape of a large fleshy tumour growing from the sub-mucous tissue, and projecting into the lumen of the gut so as to cause obstruction. It is less painful than cancer, and usually occurs at an earlier age. The symptoms are much as in the latter disease, and the treatment, when feasible, is the same, *viz* extirpation of the growth, but it will very probably recur.

Epithelioma of the Anus, &c of the skin covering the anal margin, occurs as a primary development similar to that on the lip and is then of the squamous type. It presents the usual features, *viz* an indurated nodular mass, which readily ulcerates, and runs the typical course of such a disease, infecting the inguinal glands. If large it should be treated by operative excision and colostomy, but where the growth is early good results are obtained by radium, and this has the great advantage of leaving the anal canal. The inguinal glands may also be treated by radium or excised. It is readily dealt with in the earlier stages by an operation somewhat similar to that for excision of the rectum, and the results are good because it early attracts attention.

Carcinoma of the Rectum is one of the more common forms of cancer, and while it usually occurs in the 'cancer age,' it occasionally affects young adults.

It may start in three situations

(a) In the upper part of the rectum near the recto-sigmoid junction,

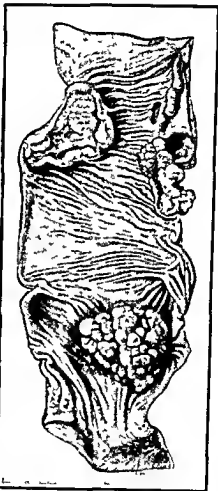


FIG 823.—CARCINOMA OF THE RECTO SIGMOID JUNCTION WITH A VILLOUS PAPILOMA OF THE RECTUM (MR NORRIS'S CASE)

This the most common site is at the tip of the examining finger and a growth here may easily be missed if a somewhat cursory examination is made of the anus and rectal ampulla

(b) In the rectal ampulla

(c) Just within the anus this is an uncommon situation The growth is histologically a columnar-celled

adeno-carcinoma and is usually found as an ulcer with raised hard everted edges It is occasionally a large projecting tumour colloid degeneration is not uncommon and it may be the termination of multiple adenomatosis Apart from the latter condition small adenomata are frequent in the proximity of a carcinoma and it is probable that many rectal cancers start as an adenoma

The growth spreads by (a) direct invasion (b) lymphatics and (c) the portal blood stream

(a) At first confined to the mucosa the growth invades the underlying muscle and gradually involves more of the circumference of the bowel There is no definite relationship between the size of the growth in the rectum the amount of circumference involved and the extent to which it has penetrated the wall and it is the last which is so important (Fig 824) Stenosis and obstruction are more common in the upper part of the rectum

and this may be intensified by invagination of the growth As the disease progresses it invades surrounding parts and thus the tumour may become adherent either to the pelvic walls or to the bladder vagina or prostate sometimes the iliac vessels or sciatic nerves are compressed causing oedema or neuralgia respectively Of course it must be understood that this invasion is in part inflammatory and due to absorption of bacteria etc. from the ulcerated surface and this



FIG 84—CARCINOMA OF THE RECTUM

The specimen was obtained by perineal excision and shows a small perforation above the growth

later it passes independently of the motions. On examination, an ulcerating crateriform mass is met with, which may be limited to one segment of the gut wall, and is then usually firm, and perhaps associated with stenosis, or it may surround the bowel, and feel soft and spongy, readily breaking down under the finger, and bleeding freely. The bowel below the growth is usually 'ballooned'. This examination is generally painful as also the process of defæcation, and sometimes the patient abstains from the latter for lengthened periods on account of the exquisite agony caused thereby. When the anterior wall is involved the bladder is often fixed to the mass, and micturition becomes painful, moreover, every time the bladder is emptied, a discharge may occur from the bowel, and this may continue even after colostomy has been performed. Marked cachexia supervenes, the digestion becomes impaired, any meal causing pain and flatulent distension, natural sleep is impossible, and if a recto-vesical fistula forms, the patient's troubles are further aggravated by the passage of faeces and flatus by the urethra.

The case runs a more or less rapid course to the fatal issue, which in a patient fifty five to sixty five years of age ensues on an average about twenty one months after the onset of symptoms, if no operation has been undertaken. Faecal obstruction occurs in about 30 per cent. of the cases, being more marked in the chronic forms, and in those where the disease starts high up the bowel on account of the peristalsis causing invagination of the mass and occlusion of the tube, but if ulceration is excessive, or the disease situated low down, obstruction is less common, invagination being here impossible, and peristalsis being expended on the onward passage of the faeces. Exhaustion from hæmorrhage, pain, sleeplessness, or toxic absorption, accounts for most of the fatal results, and septic peritonitis following the perforation of stercoral ulcers above the growth occurs in a few instances. In young people under thirty years of age the outlook is so bad that operative treatment is probably not justified, in old people over eighty years of age the progress is often so slow that operation is unnecessary.

The Diagnosis is made on the result of a careful rectal examination and the passage of blood, or any alteration of the normal bowel habits in an elderly patient, symptoms which must never be neglected. 90 per cent. of rectal growths are palpable if care is taken, and a routine sigmoidoscopy in these cases will ensure that no growth at the pelvic-rectal junction is missed. Biopsy will assist in the diagnosis if there is any doubt. An antero-posterior X ray of a barium enema may fail to reveal a carcinoma at the upper end of the rectum, since the lower end of the sigmoid overshadows this area.

The Treatment of cancer of the rectum consists in the radical measure of excision, the palliative operation of colostomy, or treatment by radium, with or without operation. In assessing the operability of a growth several factors are to be considered.

(a) *The Stage of the Growth.*—The mere size of the growth in the rectum is no indication of its operability. It should be mobile, fixation to the prostate or bladder, the side walls of the pelvis or the sacrum is generally regarded as a contra indication to radical surgery. The

posterior vaginal wall can if involved be removed with the growth. A final decision can only be made when the abdomen is opened. Secondary deposits in the liver or pelvic peritoneum necessarily render the growth inoperable but enlargement of the glands in the meso-rectum is not to be regarded as a bar to surgery since the enlargement is frequently inflammatory.

(b) **The Site of the Growth**—When the examining finger can be passed above a rectal carcinoma the growth can be removed by the operation of perineal resection an operation with a low mortality whereas a high rectal carcinoma will require some form of combined abdominal and perineal operation. This is a more severe procedure with a higher mortality. Hence a high growth even if otherwise suitable may have to be regarded as inoperable in a patient of poor physique.

(c) **The Condition of the Patient**—These operations are easier in women owing to the wider pelvis. In men there is the risk of damage to the urethra and bladder. Age must be considered in relation to the physique of the patient and the type of operation required. Obesity cardiac and pulmonary disease are unfavourable factors and chronic intestinal obstruction must be relieved by enemata, purges or bowel drainage.

Excision of the Rectum—(1) **Perineal Resection**—A permanent left iliac colostomy is performed at least ten days before the resection and the lower segment of bowel thoroughly washed out. In the male a catheter is tied in before the operation to guide the surgeon as to the position of the urethra. With the patient in the left lateral position a purse string suture is introduced around the anus and tied. The perineum is again purified and a racquet incision is made from above the sacro-coccygeal junction down to and encircling the anus. The coccyx is disarticulated through this space a finger is inserted above the levator ani and the muscle divided close to the side wall of the pelvis on both sides. By careful dissection the rectum is separated anteriorly from the urethra and prostate or the vagina. The strong fascia extending forward from the anterior surface of the sacrum is divided and the rectum stripped forwards from the sacrum. Lateral bands of fibro fatty tissue containing the middle hæmorrhoidal vessels are divided. The rectum and anus are now enclosed in a sterile glove and the anterior separation is continued till the peritoneum is exposed. It is opened and divided upwards on either side of the rectum. The meso-rectum containing the superior hæmorrhoidal vessels is divided and ligatured as high as possible. The bowel is pulled down and divided between clamps. The upper cord is invaginated and the peritoneum sutured to its anterior and lateral surfaces. A large space is left in the perineum. The wound may be completely sutured save for a small drain or the middle part left unsutured and the space packed with gauze inside a large piece of protective. In the male the catheter is left in for three days with strict asepsis in the female a catheter should be passed three times daily till normal micturition is established. If packing has been used it is removed on the third day and the wound irrigated daily.

(2) **The Abdomino-Perineal Operation**—If necessary this may have been preceded by a *cecostomy* or *colostomy*. The patient is placed in the full Trendelenburg position and the abdomen opened through the right rectus. After ensuring the operability of the growth and the absence of secondaries the small gut is packed off and the inferior mesenteric artery divided between ligatures just below the level of the aortic bifurcation. The peritoneum on either side of the rectum is incised downwards to the pelvic floor and the bowel and meso-rectum stripped forwards from the hollow of the sacrum. The two peritoneal incisions are joined across Douglas pouch the rectum separated from the vagina or prostate and the lateral bands containing the middle hæmorrhoidal vessels divided. The sigmoid is now divided between clamps. The upper end is brought out to form a terminal colostomy through a small incision in the left iliac fossa while the lower end is ligatured and covered with sterile protective. The lower bowel is pushed down into the hollow of the sacrum and the peritoneum united over it. The abdomen is closed the patient placed in the left lateral position and the operation is finished by the removal of the bowel by the perineal route.

(3) **The Perineo-Abdominal Operation**—In this method after a preliminary laparotomy the perineal operation is performed save that the bowel and the meso-rectum are not divided. The perineal wound is now partly closed over the rectum which is enclosed in a sterile glove. The patient is placed in the Trendelenburg position the abdomen opened and the rectum and lower sigmoid removed through the abdomen leaving a colostomy as in the abdomino-perineal.

In both combined operations the procedure is a severe one and restorative measures such as blood transfusion should be at hand. Apart from shock sepsis peritonitis and urinary infections account for the mortality.

The Choice of Operation—It is not possible to dogmatize in this matter. A resection should remove an adequate margin of healthy bowel above a growth. The average length of bowel removed by a perineal resection is about 8 inches and this operation is not suitable for a high rectal carcinoma. A combined operation will remove 14 to 20 inches of rectum and sigmoid and it is therefore the operation for a high rectal growth or where adenomata are present in the rectum and sigmoid above a carcinoma.

A combined operation removes the lymphatic drainage of the rectum up to the level of the aortic bifurcation. Considerably less than this is removed by a perineal resection where the meso-rectum is divided some 4 or 5 inches lower. If the lymph glands are not involved this wider removal of the lymphatic field has no advantage but if they are involved (and 40 per cent. of rectal carcinomas have glandular metastases at the time of their resection) then it should give a better chance of cure provided the growth has not yet reached the lumbar glands.

The mortality of the perineal operation is about 5 per cent. and that of a combined operation probably not less than 15 per cent.

To sum up, a *high* rectal growth requires some form of 'combined' operation

If the examining finger can be passed *above the growth* perineal resection should be performed, particularly if the growth is early or the patient's physique is poor. If the growth is not early or if adenomata are present above it a 'combined' operation may be performed, provided the patient is fit.

A number of other operations for rectal cancer have been performed, some aiming at the restoration of continuity in the rectum. They are rarely possible, and will not be described here.

Prognosis.—Somewhat more than half the cases of rectal cancer are inoperable when they seek advice. Of those surviving the operation, some 60 per cent. are alive and free from recurrence in five years. The prognosis is obviously worse in those cases in which the glands are involved.

The Palliative Treatment of Rectal Cancer.—A left iliac colostomy should be performed, not only to prevent obstruction, but because it renders the patient more comfortable. Radium and X rays are sometimes used in the treatment of an inoperable growth, but they are of doubtful value.

CHAPTER XLIII

SURGICAL AFFECTIONS OF THE KIDNEYS

General Remarks—The kidneys are placed on either side of the middle line and extend from the eleventh rib above to midway between the last rib and the iliac crest below the right kidney being somewhat lower than the left owing to the presence of the liver. The hilum is situated opposite the spinous process of the first lumbar vertebra and the upper ends of the organs are nearer to the spine than the lower.

Exposure—The kidneys may be approached by two chief routes
1. the lumbar and the abdominal

The Lumbar incision commences at a point corresponding to the outer border of the erector spinae and inch below the last rib extending downwards and outwards in the direction of the fibres of the external oblique towards the anterior superior iliac spine. The posterior portions of the abdominal muscles and the fascia lumborum are divided *scissars* and the fatty tissue surrounding the kidney is thus easily reached and opened. Variations of the incision must be made to suit the particular requirements of the case.

In the Abdominal operation the kidney is exposed from the front usually through a free paramedian incision the peritoneal cavity is opened or not as may be thought necessary. If the peritoneum is opened the colon is displaced inwards and held aside as also the other intestines by abdominal cloths the peritoneum covering the posterior abdominal wall is incised to the outer side of the colon and the organ thus reached. When however the kidney is enlarged it may be unnecessary to open the peritoneal cavity as the colon and other peritoneal contents are displaced inwards.

Examination of the Kidney—1. Manual examination of the kidney is made with the patient on the back with the legs raised the head supported by a pillow and the mouth open. The surgeon kneeling or standing at the side of the couch places one hand under the loin and presses it upwards whilst the other is gently but firmly pressed backwards in the lumbar region especially during expiratory movements. Unnatural mobility enlargement or displacement downwards of the organ will be thereby detected as also irregularities in outline or modification of tension.

An enlarged kidney is recognized by the following general characters. A swelling is noticed in the loin which is shaped more or less like the kidney with its outer border rounded and a notch being occasionally though rarely felt on the inner border. The flank is always dull on percussion the note remaining unaltered whatever the patient's position and intestine never finds its way behind the tumour. The passage of the colon in front of the kidney not unfrequently gives rise to a band

of resonance over its anterior surface the bowel however, soon gets pushed aside inwards as the enlargement increases. On the right side it is not unusual for the renal dulness to be continuous with that due to the liver there is always distinct resonance below and to the inner side of the mass towards the pelvis thereby distinguishing it from a pelvic swelling. The mass moves on respiration though less distinctly than the liver or spleen.

On the left side it has to be distinguished from an enlarged spleen the latter viscus hugs the anterior abdominal wall and has no gut in front of it whilst the loin is usually resonant.

2 A radiographic examination of the kidneys and ureters is often necessary in order to ascertain whether anything in the nature of a calculus is present (Plate XXVII). The use of a soft tube will often enable the lower pole of a normal kidney to be detected still more obvious does the same part of an abnormally enlarged organ appear especially if the seat of chronic inflammatory trouble or of a malignant tumour.

There is now not much difficulty in making certain of the presence or absence of a stone in the kidney or ureter although the permeability to the rays of a pure uric acid calculus still renders mistakes possible. A large stone of this character held in the hand in front of the screen casts no shadow deeper than the muscles of the thenar eminence. Oxalate calculi or those formed of phosphates, cystine, or of a mixed composition, ought in all cases to be demonstrable and their number, site and position ascertainable.

The differential diagnosis of the shadows of calculi from those produced by other conditions which may appear on the plates has been rendered easier by the more perfect detail which can now be obtained in the radiograph. In most cases it is possible to show the outline of the kidney, as well as the stones contained in it, and one can thus eliminate the shadows produced by calcified mesenteric glands, bowel contents, or appendicular concretions. Gall stones are occasionally visible, and this may lead to a mistake in diagnosis. Calcified caseous deposits in old standing tuberculous kidneys also cast shadows on radiography, but they are recognized from calculi by their more diffuse outline and want of definition, together with the clinical history of the case. One would again emphasize here the necessity for the radiographer and clinician to work together, only coming to a decision after consultation.

The positive diagnosis of ureteral calculi is sometimes more difficult, as they have to be distinguished from phleboliths, calcified pelvic glands, appendicular concretions, bowel contents, calcified appendices epiploicæ and calcified uterine fibroids, whether pedunculated or sessile. It may be necessary to pass an opaque bougie up the ureter and repeat the examination before a diagnosis can be made. Pelvic glands are nearly always circular and frequently multiple, although it is not uncommon to find a single calcified gland opposite and internal to the iliopectineal eminence on one or both sides. Calcified inguinal glands are easily recognized by their superficial position on stereoscopic examination. Bowel contents are excluded by repeating the examination after effective purgation, and, indeed, this is a course which should always be

followed except in cases which are absolutely characteristic. Calcified fibroids simulating ureteral or vesical calculi can generally be detected on clinical examination.

The preparation of the patient for the examination is of great importance especially in one of heavy build. The intestine must be empty in order to get good results and the patient should if possible be kept on light diet for some days previously. A course of purgation for two or three days followed by a long tube enema on the morning of the examination before the patient has had any food is the ideal preparation.

A good deal of useful information can be obtained as to the physical condition of the ureter and of the calyces and pelvis of the kidney by the proceeding now known as pyelography which consists in injecting through a ureteral catheter a solution of sodium bromide (20 per cent) or of sodium iodide (15 per cent) up the ureter so as to fill the pelvis and then taking a radiograph. A normal pyelogram is represented in Fig. 826 and it will be noted that the shadows of the calyces are concave or cup-shaped owing to the projection into them of the pyramids. The pelvis of a normal kidney has a capacity of 5 to 8 c.c. of solution but this is much increased in pathological conditions such as hydro-nephrosis. When infection is present the terminal shadows of the calyces are usually convex or flat. With this process it is easy to detect kinks or other abnormalities in the shape of the ureter and its attachment to the pelvis as also minor degrees of hydro- or pyo-nephrosis and irregularities in the shape and size of the kidney itself. Doubtful shadows may also be shown to lie quite outside the renal or ureteric region by this means. Of course it must only be undertaken by experts in the use of the ureteral catheter.

Now numerous radio-opaque drugs can be given intravenously which are excreted by the kidney in sufficient concentration to show the outline of the kidney calyces and pelvis and are very useful when cystoscopy is not possible or when it is desired to compare both kidneys. Pictures are usually taken two minutes, ten minutes and thirty minutes after injection and some indication of renal function is obtained by delay in excretion which may be noted. Parabrodil and uroselectan B are the two most satisfactory being almost completely non-toxic rapidly excreted and giving good shadows the dose of either is 20 c.c. of solution which is easier to administer than other drugs requiring a 100 c.c. dose.

Examination of the Renal Functions.—No serious operation on the urinary organs ought ever to be undertaken in the absence of more or less satisfactory knowledge as to the functional capacity of the kidneys. When the surgeon is considering the question of removing one kidney it is not sufficient merely to know that a second kidney exists; he must be assured that it is capable of carrying on efficiently if left to itself. In conditions moreover of the lower urinary organs which may be associated with secondary changes in the kidneys serious operations should not be undertaken unless the quality of the renal function has been estimated. Many a patient has lost his life after prostatectomy

from the reflex effect of the operation on damaged kidneys incapable of standing the strain of such a procedure

The tests for the determination of renal efficiency are complicated, and at present cannot be relied on absolutely. Their very multiplicity suggests the uncertainty that still exists as to their value, and the differences of opinion as to their respective merits are considerable. It is only possible here to indicate the characters of those with the best reputation.

1. **The Amount and Quality of the Urinary Secretion** must be carefully noted in all cases of disease of the kidneys or of the urinary organs where it can be of any significance. The specific gravity should be regularly noted, and the amount of the output of urea, a persistent low specific gravity and a defective urea content are always danger signals. The amount of urine passed apart from a knowledge of its specific gravity is no guarantee of the efficiency of the renal secretion. The amount of urea output is little guarantee apart from a knowledge of the



FIG 826—PELVIS IN DIASTOLE WITH MAJOR AND MINOR CALYCES WELL DEFINED



FIG 827—PELVIS IN SYSTOLE MINOR CALYCES NOT VISIBLE. NARROWING OF COMMUNICATING CHANNELS AND CONTRACTION OF PELVIS

character of the food taken. moreover, it does not suggest or give any clue as to the capacity of the kidneys to deal with an emergency, nor does it show the amount of urea still existent in the blood.

2. **The Urea Concentration Test** is devised with a view to discover the capabilities of the kidneys to react to a stimulus. All fluid is withheld from the patient for six hours, and then a dose of urea (15 grammes in 100 c.c. of water) is administered. The volume of urine passed hourly for three hours is measured, and the percentage of the urea content, as compared with the dose given, carefully investigated. If the urea in the urine exceeds 2.5 per cent, the kidneys may be considered to be acting adequately, if the amount is between 2.5 and 2 per cent, the renal function is probably sufficient, but it is likely that some damage to the secretory apparatus is present, and it may be desirable to estimate, in addition, the amount of urea in the blood. If the urea content is below 2 per cent, the kidney function is prob-

ably unsatisfactory. Excessive excretion of urine (diuresis) somewhat vitiates these figures and that must also be taken into account.

3 The Estimation of Urea in the Blood, especially if it can be compared with the output of urea in the urine would at first sight appear to be a matter of great value. Inasmuch however as the amount is largely dependent on the diet of the patient and gives no indication of the power of the kidney to react to a stimulus its value as a test of renal efficiency has been rightly depreciated. The amount of blood urea normally in patients on a hospital diet varies from 20 mgrms. per cent in young people to 50 mgrms in older people 70 mgrms. per cent in an elderly patient would indicate renal insufficiency.

4 The Elimination of Dyesuffs has been used for some years as a means of determining the functional activity of the kidneys and although one cannot be certain that any parallelism exists between such excretion and that of the products of nitrogenous metabolism yet it has its value and particularly in estimating the relative activity of the two kidneys if the urine from each is collected by a ureteral catheter. (a) The methylene blue test was much used formerly but has been displaced by other methods. However for one who is not an expert it may prove of value to determine whether or not a second kidney exists in view of a possible nephrectomy. 5 minims of a 10 per cent solution are injected into the gluteus maximus and within ten or fifteen minutes it should be possible to see blue jets of coloured urine escaping from the ureteral orifices by means of a cystoscope. The functional value of such a kidney is not determined thereby. (b) Indigo carmine has now largely taken the place of methylene blue and may be introduced intravenously (10 c.c. of 0.4 per cent solution). The colour should appear within three to six minutes and the depth of the coloration is some guide as to the renal efficiency. Delay in appearance and feeble coloration are indications of imperfect renal function. It is difficult to form any judgment as to moderate degrees of impairment of function. (c) Phenol-sulphonephthalein is also employed in much the same way but is rather more accurate. A draught of water is administered and 0.006 gramme of phenol sulphonephthalein is injected subcutaneously. The urine is collected for two hours and rendered alkaline by the addition of caustic soda (25 per cent) which produces a brilliant red colour. Each hourly specimen is made up to 1 litre with distilled water and compared in a colorimeter with a standard solution of phenol sulphonephthalein containing 0.003 gramme in a litre. The percentage of the dye excreted in each hour is thus estimable. The normal secretion is 40 to 50 per cent for the first hour and 20 to 25 per cent for the second. A figure below 45 per cent for the two hours indicates some degree of renal insufficiency.

In conclusion it must be remembered that none of these tests can be relied on by themselves and none or all of them combined can be used to the exclusion of the facts ascertained by clinical examination. The laboratory worker must be the assistant of and not the dictator to the clinician.

Diminution in or loss of the functional activity of the kidneys results in an accumulation of toxic products of varying characters in the blood

which leads sooner or later to the development of a condition of **Uræmia**, which may have a gradual or sudden onset, and be represented by a multiplicity of varying symptoms. Headache, vomiting, and convulsions are probably the most characteristic features, but there are many other suggestive manifestations, such as delirium, various paralytic asthmatic attacks, etc.

Congenital Affections of the Kidney.—Many different malformations and displacements are met with affecting this organ.

The chief **Malformations** are as follows (1) Complete absence of one organ, a very rare condition (2) Congenital atrophy of one kidney, it being represented by a mass of fatty tissue. In both cases the other kidney is correspondingly enlarged and hypertrophied (3) The kidneys may be fused together, either forming one large organ in the median line and more or less normal in shape, or sometimes constituting the so called **horseshoe kidney**, the convexity being directed downwards. The latter condition is not very uncommon, being present once in about 1,100 bodies examined, it is usually associated with an increased number of ureters or renal vessels (4) Deep lobulation of the kidney, as in some animals, is occasionally seen, especially if the organ is displaced, this may be carried to such an extent as to divide it into two or more portions (5) The ureter and pelvis may be double, this malformation affecting the pelvis alone, or extending as far as the bladder (6) The renal artery may arise from the aorta in two or more main branches.

The majority of these malformations are of very little clinical importance, except in the operation of nephrectomy, when they may necessitate some modification of the usual proceedings. They are apparently more than normally liable to infection.

Congenital Displacement of the Kidney occurs about once in every thousand individuals, the organ being either depressed, so as to lie over the sacro iliac synchondrosis or sacral promontory, or raised above its normal position. The left kidney is more frequently affected in this way than the right, and, when lying in the iliac fossa, the descending colon is usually displaced inwards, so that the rectum starts to the right of the middle line. The adrenal bodies retain their normal position, and do not move with the kidney.

Cystic disease, sarcoma, and hydronephrosis may also occur congenitally, and will in turn be described below.

Movable and Floating Kidney.—The normal kidney is not a fixed organ, but moves up and down on respiration, although usually this movement cannot be detected on palpation. It is therefore necessary to define as precisely as possible what is meant clinically by the terms 'movable' and 'floating' kidney. Three stages of abnormal mobility may be described (i) A **palpable kidney** is one the lower half or more of which can be definitely felt on deep inspiration (ii) A **movable kidney** is one in which the examining hand can define the upper end of the organ, and can restrain it from returning to its old position during expiration (iii) A **floating kidney** is one which can be moved freely about the abdomen in all directions, and even across the middle line in some cases. Formerly this last term was applied to a supposed

congenital lesion in which the kidney was attached to the posterior abdominal wall by means of a mesentery it is more than doubtful whether such a condition exists

In the earlier stages the movements occur within the fatty capsule which surrounds the organ but later on mild attacks of inflammation attach the fatty to the fibrous capsule and the kidney with its associated fatty envelope moves behind the peritoneum. Two forms of movement are possible (1) An up-and-down or in-and-out movement in one plane (*cinder sifting* movement) the kidney merely swinging on its pedicle or (2) a movement of torsion may accompany this either round a transverse axis when the lower end of the kidney becomes prominent or round a vertical axis when the outer convex border swings forwards. In the latter case kinking of the ureter or renal vessels is very likely to ensue

Movable kidney occurs more frequently in women than in men (10 to 1) and more often on the right than on the left side (12 or 13 to 1) partly because the renal vessels are longer on this side than on the other and partly because the descending colon is more fixed than the ascending

Causes.—The kidney is placed between the layers of the perinephric fascia which in turn are derived from a splitting of the fascia transversalis. In children this perinephric capsule is attached closely to the kidney front and back without any intervening fat but as development proceeds fat is packed in around the kidney in increasing amount and hence in stout subjects the perinephric capsule is considerably distended and the kidney is firmly supported. In addition to this however the tension of the peritoneum the maintenance of the intra abdominal pressure and the support of the muscular abdominal parietes have much to do in keeping it in place. Anything that seriously modifies these three factors may lead to displacement and mobility of the organ. Parturition accounts for some cases—firstly because of the sudden diminution of the intra abdominal pressure and secondly owing to the resulting pendulous and relaxed state of the abdominal muscles especially if the patient too early resumes the erect posture or undertakes physical work without efficient external support hence it is more frequent among the poor than among the rich. It may also follow the removal of large abdominal tumours which stretch the abdominal walls or rapid emaciation whereby the perinephric fat is absorbed tight lacing or traumatic influences may also be responsible for some cases. It is frequently associated with that form of displacement downwards of the abdominal viscera which is known as *Glenard's disease* or *visceroptosis*. Constipation is an important element in the production of movable kidney and probably acts by the loaded caecum dragging upon the anterior layers of the perinephric fascia and thus displacing it forwards

Symptoms.—A movable kidney is often discovered by accident and may be entirely free from symptoms. In some cases the patient comes under observation because she has observed a movable lump in the abdomen which on handling is painful the pain being often associated with nausea and vomiting. In other cases pain and vomiting bring the

patient under observation, the doctor discovering the movable kidney. The pain is referred to the back, or perhaps shoots along the ureter to the groin, testis, or labium majus. Vomiting is a significant sign, and the surgeon should never omit to examine the loins in cases of obstinate vomiting with no apparent cause. Periodical exacerbations of these symptoms, with a temporary diminution of the amount of urine, result from kinking of the ureter (*Diell's crises*) sudden relief, followed by an increased flow of urine, possibly containing some mucus, indicates that the organ has returned to its normal situation. Repeated attacks of this type may result in pyelitis and hydronephrosis. On examining the abdomen, a movable tumour can often be observed with ease if the abdominal parietes are not loaded with fat, and on manipulation pain and vomiting may be induced. The adoption of the genu pectoral position will sometimes enable a movable kidney to be more certainly felt, whilst a distinct loss of resistance is noticed external to the erector spinæ on the affected side.

The patient is usually of a neurotic type, but possibly this may result in part from the mobility of the organ, which necessarily involves a certain amount of traction upon the sympathetic centres in the abdomen. Evidence of the displacement of other abdominal viscera is often found, so that the detection of a movable kidney does not necessarily explain the whole case, or indicate operation. After many an operation for movable kidney the symptoms (pain, vomiting, etc.) have persisted, even though the organ remained anchored to the abdominal wall.

Treatment.—In the great majority of cases of movable kidney operation is not required, and, indeed, it is usually unwise to tell the patient that such a condition is present. If it is associated with marked debility, bodily or nervous, and perhaps with general enteroptosis, a rest-cure in bed for six weeks, with abdominal and general massage and an abundance of milk and fatty foods, will do much to steady the kidney and unprove the general condition. The application of a carefully-fitted kidney support will then suffice to keep her comfortable. This may advisably consist of an air-cushion fitted into an abdominal belt, the cushion should be triangular in shape, its sides corresponding to the costal border, Poupart's ligament, and the linea semilunaris, it is put on in the recumbent posture, and for choice with the pelvis raised.

The indications for operation are (1) Extreme mobility, so that the organ cannot be fixed by a support, (2) extreme tenderness, so that a support cannot be tolerated, (3) the recurrence of acute attacks of pain and vomiting (*Diell's crises*), and (4) the supervention of hydronephrosis or pyelitis.

Nephrorrhaphy or *Nephropexy* is the name applied to the operation for fixing the kidney. It is obvious that a rounded body like the kidney with a smooth fibrous capsule is not easily fixed, and the more so since the renal parenchyma has great absorbent powers, so that sutures, even of silk, passed through its substance are readily disintegrated and absorbed, hence, although the kidney may seem to be efficiently immobilized at the completion of the operation, it readily becomes loose again. There are only two certain methods of fix- g

prostatic urethra of male infants. When unilateral, stenosis of the ureter may be present, this occurring most commonly at its junction with the pelvis or at its entrance to the bladder, in some cases the ureter may be kinked over an abnormally low branch of the renal artery and obstructed by tough fibrous bands that accompany such vessels. Hydronephrosis may be seen in abnormal kidneys of horse-shoe type, or in case of double ureter, when the part of the kidney connected with one ureter only may be affected. The amount of distension in some of these cases may interfere with parturition until the abdomen has been tapped. Infants with bilateral congenital hydronephrosis that are not born dead do not often live for more than two years.

(2) Acquired hydronephrosis may be classified under the following headings. Obstruction (a) in the lumen of the ureter, most commonly by stone, more rarely by growth, such as villous papilloma of the renal pelvis and possibly by blood-clot. (b) In the wall of the ureter by inflammatory swelling of the mucosa, by ureterocoele (ballooning of the intravesical portion of the ureter behind a congenitally stenosed orifice), by stricture resulting from healing of ulcerated area caused by a stone, from contraction of fibrous tissue in bilharziosis and other conditions, or by tumours. (c) Outside the ureter by pressure from cicatrices following pelvic cellulitis, from tumours and other swellings in the pelvis, among which must be remembered a bladder diverticulum, which may often distort one ureter near its entrance to the bladder. (d) By kinking of the ureter in cases of movable kidney. (e) In the urethra by stricture, prostatic enlargement, or penile carcinoma; in such cases the dilatation will be bilateral. (f) Of nervous origin, those cases of hydronephrosis for which no obvious cause can be found, and previously classified as 'idiopathic', these occur in early adult life, and are now said to be due to unco-ordination of the neuromuscular mechanism probably of 'sympathetic' origin.

The words 'open' and 'closed' are used according to the escape or not of urine from the hydronephrosis.

It must be clearly understood that a sudden and absolute block never leads to hydronephrosis. Should it occur as the result of impaction of a calculus in one of the ureters or of ligature of the ureter, as has occurred in hysterectomy, the secretion on that side is totally suppressed as soon as the tension within the pelvis and calyces is sufficiently high. Atrophy of the renal epithelium follows after a time, but if the obstruction is relieved within two weeks of its incidence, the secretion of urine will probably be re-established, but not after compensatory hypertrophy of the other kidney has been established. Should however the obstruction be intermittent or incomplete, so that some of the urine escapes, thereby relieving the pressure, hydronephrosis develops. Sudden and complete occlusion of the urethra likewise results in dilatation of the bladder and rupture either of that viscus or of the urethra, whilst a gradually increasing obstruction is always likely to lead to hydronephrosis. Some absorption of fluid from the hydronephrosis occurs through the convoluted tubules and lymph vessels but 'pyelo-venous' backflow only results after the trauma of excessive pressure, as may occur in careless pyelography.

Pathological History.—The earliest result of obstruction is a slight flattening of the pyramids and clubbing of the calyces which replaces the normal cupping. As dilatation proceeds two main types may result (a) The renal type occurs in cases where the pelvis is contained mainly within the kidney and the calyces dilate, a series of large cavities arise with the kidney substance becoming gradually thinned out. Calculi may be developed in these cavities and grow to a large size, often branched. (b) The pelvic type occurs where the pelvis is outside the kidney and can distend freely. In early cases the kidney retains nearly its normal design, with the pelvis becoming globular, but with increase in size the kidney atrophies, leaving a large thin walled cyst (Fig 829).

The urine is pale and of low specific gravity. The ureter above the obstruction dilates (hydro ureter) and in many cases there is dilatation of the ureter below the obstruction (cause unknown). At any stage septic phenomena may supervene, giving rise to pyonephrosis (p 1381).

The Clinical History varies considerably with the method of onset and the cause of the trouble. Frequently all that happens is a painless enlargement of the affected organ. If both kidneys are involved there may be at first some increase in the amount of urine secreted, which is pale, limpid, and of a low specific gravity, after a time the quantity diminishes, and finally anuria and uræmia follow especially if septic changes supervene, as is so commonly the case. When only one kidney is affected, the excretion may remain normal in quantity and quality, owing to compensatory hypertrophy of its fellow. An elastic swelling, fluctuant if of considerable size, is produced and presents all the physical signs of a renal tumour.

Symptoms are more frequently due to the causative agent rather than to the disease itself, pain from a renal stone, or bleeding from a growth. When due to a kink over a branch of the renal artery, there may be a history of occasional attacks of acute pain and swelling on the affected side, the swelling and pain disappearing after voiding a large quantity of pale urine, this is known as a Dietl's crisis.

The symptoms due to the disease itself are pain, which may be a dull ache due to the size of the swelling, or more acute in the stage when outflow is completely blocked. Vomiting may be due to the pain, or occur as a result of early uræmia in conjunction with dry tongue and



FIG 829.—HYDRONEPHROSIS DUE TO A STRICTURE AT THE UPPER END OF THE URETER

thirst and other signs of early renal failure. True polyuria may occur and cause increased frequency of micturition which may, however, be of reflex origin. Haematuria occurs in some cases for which no cause can be found.

Investigation.—After routine abdominal, rectal and vaginal examination and urinalysis with investigation of signs of early renal failure X-ray pictures should be taken; these may show stones or calcified abdominal glands. Cystoscopy will reveal the presence of an enlarged prostate, ureterocele or the orifice of a bladder diverticulum. Both ureters should be catheterized; the site and nature of any obstruction being noted; the rate of flow from the affected side will be very rapid, and it may be possible gently to aspirate many c.c. by a syringe attached to the catheter. The specimen collected from each ureter should be examined for organisms and pus cells and the urea percentage of the two sides compared. Pyelography should be performed and will reveal the degree of hydronephrosis or any filling defect due to growth and confirm the level of ureteric obstruction. Pyeloscopy is not yet perfected but is useful in cases of defective sympathetic innervation. A good concentration of dye is obtained by intravenous perabrodil and the simultaneous introduction of sodium iodide through a ureteric catheter into the pelvis under observation. The catheter is removed and the contractions of the calyces and pelvis are watched on the fluorescent screen and the response of the contractions noted to the administration of subcutaneous injections of drugs. Spasm of the renal musculature may sometimes be relieved by the injection of $\frac{1}{2}$ c.c. of pituitrin and normal peristalsis established. Before instituting treatment the integrity of the other kidney must be established.

The Treatment of hydronephrosis should in the first place be directed to the removal of the cause if practicable and where the obstruction exists in the prostate or urethra no other treatment is feasible. In some cases of congenital hydronephrosis due to malformation of the upper end of the ureter, it is possible to transplant it and thereby relieve the obstruction or the pinhole orifice of the ureter may be exposed within the pelvis and divided longitudinally with subsequent stitching open of the margins. This type of *ureteroplasmy* is sometimes very successful.

Obstructing bands with bloodvessels should be divided between ligatures. Pyeloplasty, excision of a flap of redundant pelvis with the suture line arranged so that the ureter is at the most dependent part may be performed if the obstruction has been relieved. These plastic operations must only be performed if the urine of that kidney is sterile.

Stenosis of the lower end of the ureter may be treated by transplanting the end proximal to the obstruction into the bladder.

Renal sympathectomy is carried out through the usual lumbar incision and the vessels and pelvis stripped of their sympathetic nerve supply. This is occasionally indicated in early hydronephrosis due to sympathetic overaction often confirmed at pyeloscopy.

In the later stages where suppuration is threatening or present nephrectomy will probably be required.

In bilateral cases with renal failure double nephrectomy is necessary.

This may be permanent or temporary as in some cases with improvement of the patient's condition the obstruction may be dealt with and the nephrostomy closed.

Pyogenic Infections of the Kidney and Ureter may develop from many distinct sources, and give rise to several allied, though distinguishable, clinical conditions. Thus (i) the infective material most frequently reaches the kidney from the blood. We have already explained the influence of oral and other types of sepsis in causing blood contamination: bacteria can readily find their way from the capillary blood stream in the glomeruli into the renal tubules, and light up an infective nephritis which quickly spreads to the pelvis. Similarly a pyæmic embolus may determine an infective lesion of the renal parenchyma, ending either in a single large localized abscess or in many scattered foci of suppuration. In cases where a focus of disease pre-exists in the kidney, e.g. stone, tubercle, or cancer, a secondary pyococcal infection adds gravely to the severity of the symptoms. (ii) When once the kidney substance is involved the trouble is only too likely to spread to the pelvis, causing a suppurative *pyelitis* (or, inasmuch as the renal parenchyma is already invaded, a suppurative *pyelonephritis*), and thence the mischief spreads down the ureter and may perhaps infect the lower urinary passages constituting a condition of *descending pyelonephritis*. (iii) A common method of origin consists in pyogenic organisms spreading upwards from the bladder to the ureter and kidney. This may arise from a primary cystitis but is seen most frequently in the affection which used to be termed 'surgical kidney' and follows in the train of many diseases accompanied by cystitis, e.g. stricture of the urethra, enlarged prostate, stone in the bladder, etc. It will be remembered that the ureter passes through the bladder in an oblique direction, and is guarded by strong sphincteric muscular fibres, and thereby the spread of infection upwards is rendered more difficult, except in some cases of rigid open ureter, as in tuberculosis, when it may be that secondary infection reaches the kidney by the lumen of the ureter. It may be (but has not been proved) that in cases of 'ascending pyelonephritis' the infection reaches the kidney by peri-ureteric lymphatics from the bladder, or even in some cases by the blood stream, and is really hæmatogenous with the bladder as the primary focus. When the phenomena caused by this infection from below are limited to a suppurative condition, it is known as an *ascending pyelonephritis*, but if to them is added an element of distension, due to the cause being of an obstructive type, then the distended suppurating kidney is known as a *pyonephrosis*. (iv) Sometimes the infection reaches the urinary passages from neighbouring organs, as in disease of the rectum or even of the appendix, in the former the bacteria are disseminated by the lymphatics, in appendicitis or diverticulitis an abscess may open into the kidney or ureter, or the latter structure may be involved in the inflammatory deposit. In the female, infection may easily spread along the short urethra from the vulva.

The organisms usually present are staphylococci, streptococci or the *B. coli*, which, as will be seen later, is constantly associated with inflammation of the bladder. *B. proteus* and *B. capsulatus mucosus*

are more rarely found, the latter is almost invariably secondary to infection of the nose with this organism

I Pylitis is the term applied to an inflammation involving the pelvis of the kidney, the calyces, and perhaps the ureter. The chief predisposing causes from which it arises are. (a) The presence of a calculus, or the passage of uric acid crystals in gouty individuals, (b) tuberculous disease, either starting primarily in the kidney, or extending upwards from the bladder, (c) extension of septic inflammation from the bladder and urethra, (d) malignant disease of the kidney, (e) occasionally in floating or movable kidney, (f) the ingestion of irritating drugs e.g. cantharides, turpentine, and even cubebs or copaiba, (g) the presence of foreign bodies, such as needles, bullets, and parasites, e.g. the *Bilharzia haematobia*,* (h) a pyæmic embolus, and (i) possibly cold. Any condition with urinary stasis will render greater the possibility of pyelitis, this may explain the frequency with which it occurs in pregnancy. In the milder cases and in the early stages it may be a simple catarrhal inflammation, but it is almost certain to become purulent if it lasts long

Whatever the cause, the pathological phenomena are the same, consisting in the lining membrane becoming congested and thickened, and secreting a muco-purulent, or even purulent, discharge. Owing to the swelling of the mucous membrane, the entrance to the ureter is encroached on, and a certain amount of distension of the pelvis and calyces (hydronephrosis) follows. The renal parenchyma is always more or less involved in the process (pyelonephritis)

The Symptoms of pyelitis consist of pain and tenderness over the affected kidney, increased frequency of micturition, and the presence of *pus in acid urine*. Necessarily, where pyelitis follows chronic cystitis, the acid reaction is neutralized if the urine in the bladder has become alkaline. The highly acid urine often causes scalding at micturition. The general condition of the patient is much upset, the temperature is high (particularly in children), and rigors are not unusual. The tongue is dry and the pulse rapid. The urine is acid, hazy (due to bacilluria) and has a fishy odour, in the later stages there may be a heavy deposit of pus and mucus. At cystoscopy the ureteric orifice of the affected side will be red and oedematous, while efflux of turbid urine may be observed.

The Treatment of pyelitis is (a) to the disease itself, (b) to the predisposing cause.

(a) Rest in bed with fluid diet is important, the patient should be encouraged to drink freely of barley water, etc., attention must be paid to the bowels. Alkalies (potassium citrate) and sedatives (tincture of hyoscyamus) should be administered in full doses six-hourly.

* Infection with *Bilharzia haematobia* occurs most commonly in Egypt and symptoms are produced by deposition of the ova in the venous radicles of the bladder. Cystitis is the result and by a process of fibrosis the bladder and ureter may become seriously contracted. Patients reach temperate climes with chronic cystitis which gives a typical cystoscopic appearance of ground glass and particles of sand. ova are sometimes found in the urine or seen in the bladder wall. As a result of continued irritation papillomatosis or carcinoma may arise.

Many cases pass into a condition of chronic pyelitis from which acute exacerbations are liable, so it is important to persevere with treatment at the first attack.

After about fourteen days (with the temperature now rising only about 1 degree) urinary antiseptics may be administered, of which hexamine (gr \times t d s) is the most popular, with this alkalis must be discontinued, as hexamine acts only in an acid urine. Others are hexyl resorcinol, methylene blue, etc. An autogenous vaccine is of assistance, and should be given in resistant cases. Lavage of the renal pelvis, 0.5 per cent argyrol being the antiseptic used, should not be used as routine, but is of help in cases of pyelitis of pregnancy in which however, the presence alone of an indwelling ureteric catheter for twenty four hours to promote drainage is often productive of excellent results. Ketogenic diet treatment should be reserved for chronic cases when other treatment has failed. The diet, by limiting carbohydrates and increasing fat, produces a ketosis which certainly improves the patient, many patients however, are unable to digest such a diet, which must be arranged by a competent dietetist. Recently mandelic acid treatment had replaced ketogenic diet, some new proprietary preparations (Mandelix, Neoket etc.) being easier and more pleasant to administer than the original tablets with which it was necessary to exhibit ammonium chloride. This treatment is based on the principles of the ketogenic diet producing a highly acid urine in itself bactericidal to which is added some empirical antiseptic action of the mandelic acid.

(b) The predisposing cause should be treated after the subsidence of the acute stage of pyelitis. X ray is always important to exclude stone, which must be dealt with. Similarly urethral stricture, septic tonsils, and other predisposing causes must have appropriate treatment.

2 **Pyelonephritis**, or inflammation of the pelvis of the kidney, together with the renal parenchyma, is almost invariably suppurative in type and either due to extension upwards from the lower urinary organs or to local lesions of the pelvis or kidney.

In almost all cases of pyelitis a certain degree of renal congestion is present, but when the condition becomes confirmed, and especially when infective matter is present in the calyces, it is certain to light up a subacute interstitial nephritis. The kidney becomes swollen and purple, with cloudy swelling of the epithelium. In the latter stages bacteria invade the pyramids and travel upwards along the lymphatics or renal tubules, giving rise to abscesses, either scattered through the connective tissue of the organ or within its tubules, in either case seriously damaging its excretory function. In both instances it is possible for many of these minute foci of pus to run together and form a large collection, which in time may become recognizable from outside, but more usually the patient dies of toxæmia or uræmia long before that stage is reached. When the affection ascends from the bladder it may commence suddenly and with acute symptoms, and then probably results from some surgical operation or simply from catheterism in a patient whose bladder is in a highly septic condition.

The organisms find their way upwards along the ureters and infect the pelvis

Sometimes the trouble is primarily cortical and of hæmatogenous origin. The organisms are then generally staphylococci and the patients children. A subcortical abscess is an early development and this may spread either towards the surface of the organ and involve the perinephric tissue or it may invade the pelvis.

A carbuncle of the kidney is similar but tends to be localized to one pole of the kidney and resemble the processes of carbuncle formation elsewhere

Clinical History—In *acute* cases the symptoms probably commence with a severe rigor associated with pain in the loins or back, headache, vomiting, great thirst and probably some amount of drowsiness, perhaps passing into a condition of coma. They may have been preceded by signs of a pre-existing bladder infection such as acute dysuria or strangury for a few days. The rigor may be repeated or the fever may remain high without exacerbations but if uræmia is present or threatening the temperature may be subnormal. The kidneys are felt to be enlarged and tender and the urine is usually diminished in amount and indeed may be suppressed entirely if any passes it is high-coloured and contains albumen and perhaps blood with some amount of pus which is probably derived largely from the lower portion of the urinary tract. The prognosis of the worst cases which supervene on old bladder trouble is nearly hopeless the patient being almost certain to die of uræmia especially as both kidneys are generally affected. In less acute cases occurring most often in young people secondary to a bacillary cystitis the symptoms often improve in a few days and quiet down but the urine is swarming with bacilli and recurrence of the trouble is not uncommon. Abscess may sometimes supervene.

In the more *chronic* cases the symptoms are those of pyrexia at first only slight but gradually increasing and taking on the hectic type. The kidney is slightly enlarged and tender the urine contains epithelial cells from the pelvis or renal casts and may be acid in the early stages but is usually alkaline in the late. As the condition progresses the temperature rises the patient wastes and is very sallow, appetite and digestive functions flag, slight delirium supervenes at night and unless the cause can be removed or dealt with effectively death from uræmia is likely to follow. If however effective treatment is possible recovery may follow but the kidney is permanently damaged, and some degree of sclerosis follows.

Treatment—In the *chronic* variety the cause must first be dealt with but the surgeon must not forget that an acute attack may be easily lighted up by injudicious instrumentation or operations. Hence it is often desirable to drain and wash out the bladder first as by a suprapubic cystotomy rather than at once to dilate or divide a stricture of the urethra or to remove an enlarged prostate or calculus. At the same time the patient is kept in bed and encouraged to drink plenty of bland fluids. An autogenous vaccine may be of slight help. A prolonged visit to the country or seaside and freedom from exposure

to wet and cold, are essential elements in the treatment. In cases where there is an abundant development of bacilli in the urine with no serious disease of the lower urinary organs, lavage of the renal pelvis after the passage of a ureteral catheter is a valuable procedure. Silver nitrate solution (1 in 15,000) may be employed, or collosol silver ($\frac{1}{2}$ or $\frac{1}{4}$ strength). This must never be undertaken by the inexperienced, only by experts. In the *acute* form the patient is kept warm in bed, and plenty of fluid, such as milk or barley water, is given, stimulants are avoided as also opium. Hot air baths, wet packs, and the hypodermic injection of pilocarpine, will suffice to get the skin to act well, and watery purgatives such as jalap and scammony are needed for the bowels. The loins are fomented or cupped, but if the urinary secretion is not re-established, or if it is suppressed, or if the phenomena of suppuration supervene, incision of the kidney and drainage of the pelvis (*nephrostomy*) are essential. It is sometimes remarkable to observe how rapidly the symptoms improve after such a procedure, and how quickly the urinary secretion is re-established.

3 *Pyonephrosis* is the term applied to indicate the association of a chronic pyelonephritis with distension of the pelvis and ureter, as a result of obstruction of the passage of urine. It may be unilateral or bilateral, open or closed. When unilateral, it is most commonly due to the presence of a calculus, or of tuberculous disease, the obstruction being caused by the swelling of the ureteral mucous membrane, if the affection is secondary to obstruction in the lower urinary passages, it is usually bilateral. The lining membrane of the pelvis is inflamed, thickened, and perhaps ulcerated, decomposing urine and pus collect in the dilated pelvis and calyces, and a soft, friable, phosphatic calculus may develop, even in cases where the originating cause is not of a calculous nature. Obstruction to the outlet may lead to such an accumulation of pus as to constitute an abscess of the kidney, whilst a certain amount of perinephritis is always present, rendering the kidney fixed and adherent to neighbouring structures. If the obstruction is low, the ureter will be thickened with dilated lumen, which will contain pus.

The *Clinical Signs* are very similar to those of pyelonephritis, but to them are added those of an enlarged, fixed, tender, and painful kidney, and abundant pyuria, usually intermittent. The temperature is somewhat raised especially at night, from the absorption of toxic products, the patient becomes emaciated, the tongue is dry, the appetite diminished, and nausea and vomiting are sometimes present. The urine is generally scanty in amount, and if both kidneys are involved, the excretion gradually diminishes, leading to a fatal issue from uræmia, unless the patient dies previously from toxæmia or pyæmia. At cystoscopy a thick column of pus may be seen issuing from an open oedematous ureter.

Treatment.—Where both kidneys are involved as a result of some urethral or prostatic affection, no special treatment directed to the kidneys is feasible, except bilateral nephrostomy, but if the condition is unilateral, nephrostomy should be undertaken, and any removable cause dealt with, and later, if the other kidney is healthy,

when the acute process has subsided, nephrectomy should be performed.

4 Abscess of the Kidney may follow any of the conditions already alluded to, in which bacteria gain access to the organ from below, the pus then collecting in the pelvis and dilated calyces. It also occurs in connection with pyæmia, and sometimes develops after the general infective fevers. It usually commences as an acute interstitial nephritis, where the abscesses are multiple and at first small, being located between the tubules or sometimes within them, the pyramids then have a streaky white appearance, due to their infiltration with pus, and the abscesses form in the cortical substance at their base. Larger collections are caused by the amalgamation of several of the smaller. In pyæmia the abscesses are preceded by infarcts, which appear immediately beneath the capsule as wedge-shaped areas of a chocolate colour, which turns a yellowish white as suppuration occurs. The kidney becomes enlarged and tender, and can usually be felt from outside, but fluctuation is rarely to be detected. The abscess may burst into the pelvis and discharge through the ureter, but when due to an ascending pyelonephritis from obstruction this is not likely to be the case. The inflammation is more liable to spread outwards through the kidney substance, and give rise to a suppurative perinephritis. The general symptoms produced are similar to those present in acute pyelonephritis. Treatment of an abscess of the kidney consists in nephrostomy for drainage purposes, or perhaps nephrectomy.

The more chronic varieties are probably tuberculous in origin, and may then attain considerable dimensions, all that is noted being the lumbar swelling, whilst pyuria is not necessarily present, owing to the ureter becoming blocked.

Perinephritis is usually recognized only when suppurative in nature, it may be primary, following boils, tonsillitis etc. and is a blood stream infection, or it may be secondary to neighbouring suppuration from kidney—most frequently a staphylococcal cortical infection—appendix, pleural cavity, ribs, spine, etc. It is usually behind the kidney, but may be found in any relation to it.

Symptoms.—In acute perinephritis signs of deep suppuration in the loin are produced viz an indurated painful swelling associated with fever and perhaps preceded by rigors. The body is held stiff and rigid with an inclination towards the affected side. Fluctuation may sometimes be detected when pus has formed, but the abscess is often so deeply placed that it is difficult to recognize at first, it is likely to point at the side of the erector spinæ or may burrow forwards between the abdominal muscles and find an exit on the anterior abdominal wall. Occasionally it bursts into the peritoneal or pleural cavities, or into the intestine. If it comes to the surface it is preceded by congestion and oedema of the skin. Chronic perinephritis gives rise to no characteristic symptoms until an abscess forms which is large enough to be felt. If of the non suppurative type, as occurs sometimes with tuberculosis or chronic staphylococcal abscess, much fibrous tissue may be laid down forming a hard fixed swelling and rendering operative interference very difficult.

Treatment in the suppurating variety consists in giving exit to the pus through an incision at the outer border of the erector spinæ the cavity is then carefully examined and the cause of the suppuration if possible determined and treated according to the requisites of the case

Tuberculous Disease of the Kidney occurs in one of three forms

(a) **Miliary Tuberculosis** arises in the course of acute general tuberculosis when miliary tubercles will be found studding both organs Treatment is impracticable

(b) **Tuberculous Nephritis** is the term applied to a toxic condition of both kidneys which show cloudy swelling as a result of extensive and usually obvious tuberculous infection else where e.g lungs Tuberculous bacilluria may be present and also a considerable amount of albumen but there will be no pus cells Local treatment is of no avail and it is accordingly important to distinguish this medical renal tuberculosis from surgical renal tuberculosis

(c) **Primary Tuberculosis (Surgical Tuberculosis)** of the kidney is generally unilateral in the early stages (80 per cent) but is bilateral in 60 per cent of cases at death it is more likely to be bilateral in children The infection is by the blood stream and a tubercle is deposited at the apex of a pyramid which will proceed to caseation and ulceration, from this area there will be seen streaks of infected lymphatics to the overlying capsule which will become thickened and adherent at this part and fresh tubercles may form in the cortex from this lymphatic spread Fibrosis at the apex of the calyx will lead to occlusion of that part of the kidney and to **Tuberculous Hydronephrosis**, but if secreting tissue has been destroyed in that segment **Massive Caseous Tubercle** will result **Tuberculous Perinephritis** from the infected capsule will cause adhesions and possibly abscess in the perinephric fat

Simultaneously the infection will spread to the pelvis ureter and bladder submucous tubercles occur and by their production of tuberculous granulation tissue may block the ureter with caseous debris or by stricture from the contraction of fibrous tissue The ureter may

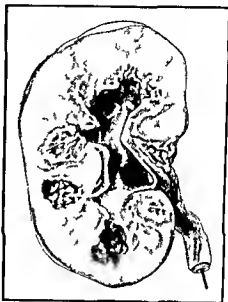


FIG 830—TUBERCULOUS KIDNEY SHOWING THICKENING OF MUCOUS MEMBRANE OF PELVIS AND URETER (FROM SPECIMEN IN KING'S COLLEGE HOSPITAL MUSEUM)

ultimately be converted into a hard thickened cord which by contraction drags upon its outlet in the bladder and may even partially rotate the bladder (Fig 830)

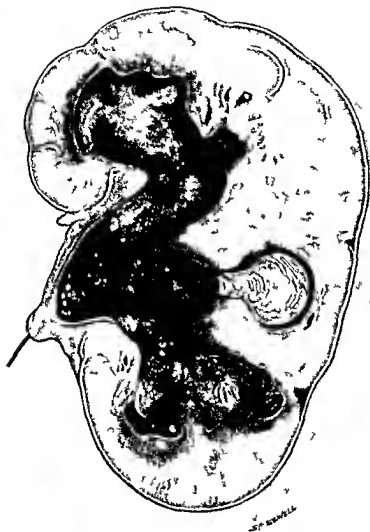
Symptoms are at first indefinite and are more likely to be present from early spread of infection to the bladder

The patient is usually a young adult and rather more frequently a male than a female. He complains of increased frequency of micturition and unilateral pain in the loin neither of which conditions is improved by rest remaining the same at night as in the day and indeed sometimes being worse. There may be a true polyuria in early stages owing to diuresis. The pain is generally of an aching character and more or less constant although exacerbations may occur taking on the type of mild renal colic in consequence of the passage of fragments of disintegrated mucous membrane or of caseous material. The urine is acid and usually contains a certain proportion of pus and the *B. tuberculi* can usually be found after centrifugalizing a complete twenty four hour specimen. Hæmaturia varies in amount and may be the first symptom to appear or may not occur at all. The bleeding may come from the kidney or from a tuberculous ulcer in the bladder; this latter is capable of causing considerable hæmorrhage. Albuminuria is not so marked as in the tuberculous nephritis cases. Loss of weight night sweats and a nocturnal rise of temperature are present in the later stages. On examination the kidney may be slightly enlarged with some tenderness but it must be remembered that one kidney may be destroyed with hypertrophy of the other and that the enlarged kidney is in fact the healthy kidney. A thickened ureter is occasionally palpable on abdominal rectal or vaginal examination.

Diagnosis—The age of the patient and his personal and family history may be of importance and he should be carefully examined for evidences of tuberculous disease elsewhere especially in the genital organs particularly prostate and seminal vesicles. Pus in acid urine in which pyogenic bacteria are not found is most suggestive of tuberculosis which will be established by finding of the acid fast Koch's bacillus. Radiography will determine the presence or absence of a stone but also of calcified caseous deposits. Cystoscopy may reveal the existence of tuberculous ulcers in the bladder close to the ureteral orifice in the earlier stages or of a retracted ureter when the latter has become transformed into a solid cord.

It is necessary to catheterize each ureter to determine whether the infection is unilateral or bilateral in cases of doubt the urine from a suspected kidney may be injected into a guinea pig which will show evidence of tuberculosis in some eight or ten weeks in positive cases.

If severe tuberculous cystitis renders recognition of the ureteric orifices difficult these may be seen after intravenous injection of indigo-carmine and catheterized. In severe cases the condition of the bladder may be somewhat improved to permit of adequate ureteric catheterization by a short course of tuberculin injections. It should no longer be necessary to expose the ureters at the brim of the pelvis in difficult cases to obtain urine specimens as the information given by intravenous pyelography will displace this severe investigation.



Large branched Renal Calculus
(King's College Hospital Museum)

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Large branched Renal Calculus
(King's College Hospital Museum)

Treatment.—Nephrectomy is the only satisfactory treatment, to be performed while the disease is still unilateral, removing the ureter as far as the brim of the pelvis. This should be followed by routine anti-tuberculous treatment of the sanatorium type and the administration of tuberculin for a long period. In bilateral cases general treatment only is possible, belladonna being useful for the milder degrees of dysuria. Excision of the presacral nerve is a useful palliative for pain and frequency (of bilateral renal tubercle or of carcinoma of the bladder), allowing sleep at night and yet not causing any lack of control.

The tuberculous cystitis usually clears up gradually after the removal of the kidney, but sometimes infection is maintained from the stump of the ureter, which must then be removed at a second operation.

Renal Calculus.—All renal concretions are primarily excreted in a crystalline form from the renal tubules, but under ordinary circumstances are sufficiently small to find their way into the pelvis of the kidney and thence along the ureter to the bladder. If, however, they are obstructed in their onward course, either on account of their size or shape, or some narrowing of the tubules, they may become lodged in the kidney substance or in one of the lower calyces, and by the gradual deposit of the same material increase in size until large enough to give rise to symptoms. Renal calculi are usually not of great bulk, occasionally, however, the whole of the pelvis and some of the calyces may be occupied by a concretion, which takes the shape of the cavity in which it lies (Plate XXVI). When many calculi are present in the pelvis of a kidney they are usually faceted. Chemically they consist most commonly of oxalate of lime, though in some few cases they are composed of uric acid or urate of ammonium, when associated with suppurative pyelitis, a phosphatic element is often present.

The Pathological Phenomena connected with renal calculi vary with their size, shape, number, and position. If situated in the substance of the renal parenchyma, they may give rise to but little trouble, being more or less encapsuled in a cavity lined by granulation tissue or surrounded by a dense fibrous capsule. Sometimes ulceration of the wall and suppurative perinephritis may follow, the calculus may even find its way into the abscess cavity, and be discharged spontaneously or removed through the loin, a urinary fistula perhaps resulting. The calculus may be gripped by the neck of one of the calyces, and thus immobilized, the calyx involved will then become dilated (localized hydronephrosis), and the kidney substance thinned over it. At times the whole pelvis is filled by a large branching calculus, extending into a number of calyces, there is then little mobility, but suppurative pyelonephritis follows, and the kidney substance is seriously damaged. When lying loosely within the pelvis of the kidney, a calculus sets up a suppurative pyelitis, and from the obstruction to the flow of urine, caused partly by the thickening of the mucous membrane and partly by the stone engaging the orifice of the ureter, produces dilatation of the pelvis of the kidney, and the phenomena of hydro- or pyo-nephrosis. If the calculus passes down the ureter, it gives rise

to the symptoms of renal colic. When small and smooth it usually reaches the bladder without much difficulty and is then voided with the urine or remains as a vesical calculus. Occasionally owing to its size or irregular shape it becomes impacted in the ureter giving rise to acute obstruction and the cessation of the urinary secretion on that side followed in time by disorganization. If the kidney thus affected is the only one available for excretory purposes or if both ureters are similarly obstructed the patient if unrelieved dies in a few days from suppression of urine (*calculus anuria*). In other cases the stone ulcerates through the wall of the ureter leading to a retroperitoneal urinary abscess or possibly to suppurative peritonitis. If the ureter is only partially obstructed by the calculus the changes which take place in the kidney are more gradual and result in hydro- or pyonephrosis.

The typical symptoms arising from renal calculus are as follows. The patient complains of pain in the loin more or less persistent and often paroxysmal in nature which is however, usually increased on exercise or jolting. It is frequently referred to distant regions but most commonly follows the course of the genito-crural nerve giving rise to pain in front of the thigh accompanied by retraction of the testicle in the female it is experienced in the labium majus sometimes it also extends down the back of the thigh. It is almost invariably associated with hæmaturia and often with pyuria. Frequency of micturition is a prominent symptom and if the pelvis is enlarged the kidney may be tender and distinctly palpable. If the calculus is lodged in the renal parenchyma the urinary secretion may be but little influenced although the characteristic pain is well marked the patient also finds that at night he can only gain relief by lying on the affected side and on manual examination the kidney though somewhat tender is not much enlarged. When the calculus lies in the pelvis or one of the calyces typical symptoms are produced. On the other hand it is an undoubted fact that stones even of large size may exist for years in the kidney without giving rise to any symptoms whatever.

The passage of the calculus down the ureter is accompanied by the symptoms known as Renal Colic. They consist of excruciating pain of a paroxysmal nature which comes on suddenly and is referred both to the loin and along the course of the genito-crural nerve. It is always associated with vomiting and severe shock the patient often lying on the floor writhing in agony with cold perspiration standing in beads on his forehead. The temperature is subnormal and the pulse weak and rapid. Strangury is usually present the patient suffering from frequent paroxysmal efforts to pass water but only succeeding in voiding a small amount and that generally blood stained. After lasting for a variable period the pain suddenly ceases as a result of the passage of the calculus into the bladder or of its slipping back into the pelvis of the kidney.

Impaction in the Ureter may occur either 2 inches below the pelvis of the kidney or near the brim of the pelvis or near the vesical orifice sometimes even protruding through it. Generally only one stone is present but occasionally more the size is rarely greater than a coffee

bean and the shape is usually somewhat elongated like a date stone. In thin persons it has been detected on palpation through the abdominal wall and when low down has been felt on rectal or vaginal examination. Persistent pain and hæmaturia extending over days or weeks should certainly suggest the presence of a ureteral calculus and the more so if with each succeeding attack the pain and tenderness are located lower down. The result may be that the stone will ulcerate through into the retroperitoneal tissue and be discharged in an abscess or more frequently the kidney becomes disorganized and perhaps the patient's life is destroyed through the resulting renal incompetence.

Occasionally the function of both kidneys is brought to an end—on the one side by the back pressure of urine due to the impaction of a small calculus on the sound side by reflex suppression of urine. In a case of this character operated on some years back all the symptoms were on the left sound side and in the unavoidable absence of a radiograph the kidney and ureter on this side were first explored and found normal. The peritoneum was then opened and an impacted stone detected in the right ureter and through a second incision this was removed. The urinary secretion was at once recommenced.

Should the ureter of a solitary kidney be blocked by a stone grave symptoms of calculous anuria, or suppression will arise. The condition is ushered in by pain in the loin of the usual character which often passes away in two or three days. The anuria is rarely complete at first a few ounces of pale limpid urine being passed at intervals whilst occasionally distinct polyuria is present. Sooner or later definite uræmic phenomena supervene the most usual period is seven or eight days after the onset but incomplete obstruction or a pre-existing condition of hydronephrosis may delay matters. The onset of uræmia is indicated by dry red or furred tongue persistent vomiting a slow full pulse becoming irregular contraction of the pupils and muscular tremors. Coma and convulsions are rarely seen and there is no dyspnoea the temperature is subnormal.

The Diagnosis of renal calculus is often a matter of uncertainty in the absence of a history of the passage of gravel or of the occurrence of renal colic. It is most likely to be mistaken for tuberculous disease the differential diagnosis between the two conditions has already been considered (p. 1384). The final determination of the presence or not of a renal or ureteral calculus is now made by radiography, which has made such advances that it may be relied on with almost absolute certainty except perhaps in the case of the small pure uric acid calculi.

Reference has already been made (p. 1367) to some of the conditions which must be observed if a reliable result is to be obtained. It is a good rule to follow that a secondary confirmatory examination should be made after an interval of two or three days in all cases where the diagnosis has not been established beyond all shadow of doubt. If a small stone has been located in the kidney and operation has for some reason or other been deferred it is always advisable that a confirmatory radiograph be taken immediately before the operation. Cases have been known where a stone had during an interval, shifted its position from the kidney to within an inch or two of the lower end

of the ureter without any symptom which could suggest the change of position

Treatment—Attacks of renal colic are treated by the use of hot hip-baths warm drinks and hypodermic injections of morphia and atropine, in the more severe cases chloroform must be administered.

In former days, when the presence of a calculus could only be suspected from the history of symptoms, the question of operation and when to undertake it was a subject of much discussion. Even at that time the late Sir Henry Morris wrote that an 'unsuspected renal calculus is a source of very real danger, and when its presence is disclosed whether by accident or by the systematic examination of the urine we should recommend its immediate removal regardless of the fact that it is not causing pain, unless the general condition of the patient contra indicates an operation'. At the present day, when radiography has placed in our hands a means of almost certain diagnosis the same advice holds good *whenever a stone is found remove it*, unless special contra indications exist (Plate XXVII). Particularly is this the case when a considerable amount of blood or pus is being passed in the urine and the patient's temperature is raised. Moreover, pain in both kidneys is no contra indication since there is no objection to operating on the second kidney some little time after the first has been satisfactorily treated. After operation the nature of the stone should be determined by analysis and the patient placed on an appropriate diet *i.e.* cases of oxalate stone to avoid strawberries spinach veal etc. The patient should be instructed always to partake freely of bland fluids and his habits of life should be regulated.

Nephro-lithotomy is always undertaken through the loin. When exposed the kidney is carefully freed from its connections and drawn up into the wound in the majority of patients it can be brought out on the loin and this is certainly a desirable manoeuvre. The whole gland is then carefully palpated as also the pelvis and upper part of the ureter so as to locate if possible the stone. Should it be distinctly felt within the kidney substance, or should an area of thinned cortex exist an incision is made over it through the renal parenchyma free hæmorrhage follows but this is readily controlled by inserting the finger into the wound or by grasping the vessels in the hilum. Should the stone not be palpable it may be possible to detect it by needling the organ and failing that an incision is made through the convex border of the kidney substance a little posterior to the mesial plane of the organ and at the junction of its inferior and middle thirds ('bloodless line' of Broedel). One of the lower calyces is opened by this means, and the interior of the pelvis is carefully and fully explored by finger and probe. It is unwise to incise the kidney to any extent, especially in searching for a small calculus, the hæmorrhage is always severe, and although checked by sutures these may be dissolved in six or eight days and secondary hæmorrhage may arise which may prove fatal. When the pelvis is much distended and the patient has previously passed a good deal of pus careful precautions must be taken to protect the surrounding tissues from infection. Bleeding is usually controlled without difficulty by stitches passed through the kidney substance, to

PLATE XXVII.



LARGE BRANCHING CALCULUS IN RIGHT KIDNEY

which in bad cases may be superadded pressure by sponge or a gauze plug in the wound. It is useless to attempt to place a ligature on a vessel divided in the renal parenchyma. Should bleeding persist, sutures of the mattress type should be introduced and tied firmly. It is wise to insert a drainage-tube down to the sutured wound in the kidney after it has been replaced. The abdominal parietes may then be closed in the usual way.

The incision was formerly made through the cortex in preference to opening directly into the pelvis, but the objection often stated that a pelvic incision heals with difficulty, and is liable to leave a fistula is not true and most surgeons now deliberately open the pelvis (pyelotomy) in order to extract stones if it is more convenient to get at them in this way. An incision large enough to introduce the gloved little finger may be made and by this means the whole kidney can be explored bimanually. Accurate suturing with catgut is generally successful in securing immediate healing, but the sutures must not encroach on the mucous membrane. Stones are removed by dressing forceps or scoop and care must be exercised to prevent any from falling back into the ureter. Large branched calculi are often held very tightly, and require an extensive incision and careful peeling off of the kidney substance. The pelvic cavity need not be irrigated under ordinary circumstances but when dilated and suppurating it is well to do so with a hot solution of 1 in 10 000 silver nitrate. Before closing the wound in the kidney or pelvis the ureter should be thoroughly examined, it is sometimes possible to introduce a ureteral sound through the open wound but this is by no means easy in the renal operation, and it is then often wiser to make a tiny opening through the pelvic infundibulum through which the sound is passed, and which is subsequently closed by a Lembert suture.

To explore and expose the ureter the incision should be prolonged downwards and forwards in a direction parallel with Poupart's ligament towards the inguinal canal. The peritoneum and its contents are pushed bodily inwards and the ureter attached to the posterior peritoneal wall can be followed down to within a few inches of the bladder. For a stone impacted near the lower end of the ureter, uretero-lithotomy is performed with the patient in the Trendelenburg position. The operation may be *trans* or *retro* peritoneal.

1 The *trans peritoneal* operation is conducted through an incision in the middle line. The stone is located, and, if possible, coaxed by the finger out of the depths of the pelvis to a more accessible position. It is then cut down on through the peritoneum, and the stone removed. The incision is closed by a Lembert suture or two.

2 The *retroperitoneal* route is the most often used, the incision being usually mid line, but without opening the peritoneum, which is gradually peeled off from the side of the pelvis on which the ureter is to be examined. An incision similar to that for tying the common iliac artery (fig 136, p 359) may also be used. The peritoneum and its contents are displaced inwards and the ureter is easily found running down on its posterior aspect. The stone is, if possible, displaced up from the pelvis and removed. Cases seem to do equally

well whether the ureter is sutured or not, granting that the stone is small. The uncertainty of the local condition, which may be disclosed on operation, leads the authors to favour the retroperitoneal operation as the safer of the two procedures. All operations involving incisions in the renal pelvis or the ureter must include drainage of the peripelvic or peri ureteric regions for seven days, by rubber tubing.

When the kidney is totally disorganized, nephrectomy may be required, but such treatment is not always advisable, especially when

sinuses have resulted from suppurative perinephritis. In such cases the renal tissue has often entirely disappeared, and disintegrating calculous material may occupy the pelvis, which is surrounded by a mass of dense fibro-cicatricial tissue, the removal of which is impracticable and even dangerous. All that should be attempted locally is the extraction of the stone and the purification of the cavity.

Purpura of the Kidney.—

It is one of the rarer causes of hæmaturia, and in quite a number of cases is due to a streptococcal infection of the throat, teeth, or bowel. Fortunately, the exhibition of horse serum by the mouth usually has an immediate effect in checking the bleeding tendency, but nephrectomy may be required. In bilateral recurrent cases splenectomy should be considered.

Tumours of the Kidney.—

The different forms of tumour which originate in the kidney may be classified as the simple and the malignant.

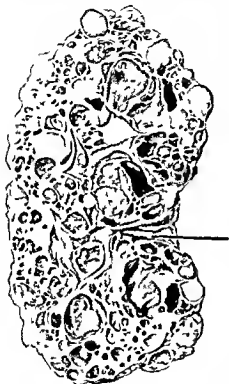
FIG. 331.—CONGENITAL CYSTIC DISEASE OF THE KIDNEY (KING'S COLLEGE HOSPITAL MUSEUM)

A probe has been passed into the ureter

nant. Several cystic conditions also occur. The general features of an enlarged kidney have been already described (p. 1365).

The simple tumours of the kidney are

1. Diffuse Cystic Disease (or as it has been termed, adenoma of the kidney) which may be congenital or acquired. It is almost invariably bilateral. The kidney is enlarged and occupied by cysts varying in size, but rarely exceeding that of a cherry, they are lined with



epithelium which is generally flattened, and filled with a limpid fluid containing urea, and perhaps cholesterine. The cysts are very numerous, and project from the surface of the kidney as nodular elastic outgrowths.

The pelvis remains unaffected until the later stages of the disease (Fig 831). Generally the whole kidney is involved, and may attain enormous dimensions, constituting large swellings, which can be easily felt, and with a distinctly nodulated surface, occasionally the growth is limited to one portion of the organ. The origin of this condition is uncertain, but it is supposed to be due to the persistence of the mesonephros (or Wolffian body) in the substance of the true kidney (or metanephros), and its development into cysts. In the early stages no symptoms are produced, except perhaps a sense of dragging weight in the loins from the size of the tumours, but later on the secretion of urine is interfered with to such an extent as to produce renal incompetency and finally uræmia. Hæmaturia is sometimes the cause of drawing attention to the condition. The tendency of this affection to involve both kidneys prevents any hope of benefit from operation. Puncture of the cysts by relieving pressure on the renal substance may produce temporary amelioration.

2 **Papilloma** of the renal pelvis is a rare condition, characterized by the development within its cavity of a villous mass, identical in structure with that met with in the bladder. It has usually been observed in elderly people, and the chief, if not the only, symptom is excessive hæmaturia. Although the growth is of an innocent nature, it is very near the border line of malignancy, because implantation growths quite commonly occur after removal. Diagnosis is made by pyelography, which shows a filling defect of the renal pelvis. Nephrectomy is the only treatment of any permanent value.

3 **Angioma of the Renal Pelvis** is the rarest of the innocent growths of the renal pelvis, and gives rise to painless hæmaturia. Generally nephrectomy is required, but a few cases have been treated by local excision.

Malignant tumours of the kidney may be divided into

1 **The Sarcomata of Infants** (embryoma), which are often congenital, but may be acquired within the first few years of life. They are encapsuled, the kidney substance being spread over them, and consist of round or spindle cells, the latter often showing a cross striation, resembling that of muscular fibres. Some pathologists regard these tumours as teratomata. They grow to a great size, and may affect both organs, with little pain or hæmaturia. Death results from general dissemination or from exhaustion, or may follow the detachment of a sarcomatous embolus, which travels upwards and blocks the pulmonary vessels. **Treatment** by nephrectomy has given most unsatisfactory results, the operative mortality having been high and recurrence within a short period almost invariable. The operation itself is not particularly difficult, but a large incision is required, and care must be taken to avoid displaced structures, such as the inferior vena cava.

2 **The Sarcomata of Adults** occur between the thirtieth and fiftieth years of life, and are of the spindle-celled variety, often originating

from the capsule. Only one kidney is generally involved, giving rise to a rapidly growing swelling associated with hæmaturia and perhaps pain. Calculi are often found in the pelvis of such organs, and may be causative or consecutive. Secondary deposits form in the viscera, extension through and beyond the capsule is not uncommon, and death is usually due to exhaustion. The results of nephrectomy have not been very encouraging.

3 **Primary Carcinoma** is an uncommon form of tumour in the kidney. It presents the same clinical features as a sarcoma except that there is rather more pain, and can only be recognized on microscopic examination. One symptom, however, requires special mention, since it is extremely suggestive of the presence of cancer, viz the development of a varicocele. It is due to the pressure of enlarged and cancerous lymphatic glands upon the root of the spermatic vein, and hence, whenever an elderly person develops a varicocele a careful examination of the kidney on the affected side should always be instituted.

4 The commonest tumours of the kidney, however, are the so-called **Hypernephromata** (75 to 80 per cent of all renal tumours). They are looked on as growing from accessory and misplaced adrenals (*adrenal rests*) and develop primarily in the cortex as localized growths, gradually increasing in size and encroaching on the pelvis. This theory is not universally accepted as some surgeons regard these tumours as true carcinomata of the renal tubules. They are of firm consistence, but show areas of necrosis and softening and deep red patches due to hæmorrhage (Plate XXVIII), the section is more or less mottled, and some bright yellow areas are very evident. On microscopic examination their appearance closely resembles the zona fasciculata of the adrenal bodies, but this theory as to their origin is not universally accepted. They are malignant in type being disseminated by the blood-vessels and secondary growths are found in the lungs, liver, or bones.

Hypernephromata usually occur in adults between fifty and seventy years of age and are of comparatively slow growth. They give rise to hæmaturia but it is late in appearance and less persistent than in other malignant growths of the kidney. Pain is often well marked and referred to the loin, it is of two main types—a persistent aching pain which may be very severe and wearing and a colicky pain, due to the passage of clots down the ureter. The renal enlargement is usually characteristic but outgrowths from diffusion beyond the capsule may render the swelling of irregular shape. Treatment consists in removal if there is no evidence of secondary deposits in the lungs or elsewhere. The operation is by no means simple in cases that are at all advanced as serious adhesions in various directions may be present and the bleeding may be severe.

Various **Cystic Conditions** of the kidney must be noted in addition to the general cystic disease already described.

(a) **Hydatid Disease** affects the kidney as it may involve any other organ in the body. It starts either beneath the capsule or in the glandular substance. In the former case it is likely to form a rounded projection which may be detected on palpation of the loin, in the latter it expands, or even destroys, the whole of the glandular tissue,

PLATE XXVIII



Hypernephroma of the kidney
(Museum Royal College of Surgeons)

and may burst into the renal pelvis, the cysts being passed along the ureter, accompanied by more or less colic. Suppuration may complicate matters, but, unless the cyst has ruptured into the renal pelvis diagnosis is scarcely feasible apart from an exploratory incision. *Treatment* consists in cutting down on the kidney, and enucleating the mass, if possible. Failing this, drainage may be undertaken but in bad cases *nephrectomy is necessary*.

(b) *Dermoid Cysts* have also been found

(c) *Serous Cysts* are occasionally met with, arising possibly as a result of obstruction to some of the ducts, or due to lymphatic obstruction. Rounded swellings, simple or multiple, are produced, growing outwards from the cortex, and containing a thin fluid with a small amount of albumen and saline substances in solution. They give rise to no symptoms except from their size, and rarely require treatment other than simple aspiration or drainage. If discovered at an operation, and of considerable size, they should be incised, and either dissected out, or the outer wall cut away, and the inner left continuous with the renal capsule.

(d) Not unfrequently a number of small cysts develop in connection with *chronic granular nephritis*, and they are of no clinical importance.

Nephrectomy, for total removal of the kidney, is performed for the following conditions: (a) For tuberculous disease, when unilateral; (b) for calculous pyonephrosis when the renal parenchyma is disintegrated; (c) for hydronephrosis, when palliative measures or drainage have failed to give relief; (d) for malignant disease; (e) for traumatic lesions, such as disintegration or rupture, especially if complicated by laceration of the peritoneum, and (f) for some cases of ruptured ureter, and fistula from pelvis or ureter when attempts at closure have failed.

Before undertaking the excision of any kidney, however diseased it is essential that the surgeon should satisfy himself as to the existence of another, and also, if possible, ascertain that it is capable of undertaking the increased duties which will subsequently fall upon it (p. 1365).

Nephrectomy may be undertaken through the abdomen or through the loin, but sundry combinations or modifications of these operations have been recommended by various authorities.

The *Abdominal Operation* is chiefly utilized when the organ is much enlarged, on account of the readier access obtained, especially to the pedicle. The peritoneum must be carefully protected from septic contamination, when the pelvis and the upper part of the ureter are distended with decomposing pus. The colon and peritoneum are displaced inwards, the kidney is then freed from its adhesions to surrounding tissues, the surgeon endeavouring to keep outside its true capsule, but inside the layer of condensed perinephric tissue. Special precautions must be adopted in dealing with the deep aspect of the tumour, particularly on the right side, where it is occasionally adherent to the inferior vena cava. The mass is now lifted from its bed, and its pedicle, consisting of the ureter and renal vessels isolated. These latter are secured separately by ligature and divided, a clamp being

applied to the distal ends. The ureter is dealt with in the same way, small pieces of gauze being packed round so as to receive any secretion which may escape. The wound in the abdominal parietes is closed in the usual way, provision for drainage being made either through the loin or from the front. Considerable shock is often experienced from this operation.

Occasionally the perinephric adhesions are so firm and extensive that the only practicable plan of removing the organ is to enucleate it from within the capsule as far as the hilum, the capsule is then torn or cut through so as to expose the pelvis and renal vessels which are secured.

The *Lumbar Method* can be employed when the kidney is not too greatly enlarged. The organ is exposed by the incision already described, enucleated from its surroundings, and the pedicle dealt with as in the abdominal operation.

Should it be desirable to include the ureter in the scope of the operation, the incision may be prolonged into the groin in the direction of the fibres of the external oblique, and the peritoneum and its contents pushed forwards, by this means it can be traced down almost to the bladder. It may be desirable, however, to delay the excision of the ureter to a later date, effecting it through an anterior incision as for a ureteral calculus (p. 1391).

CHAPTER XLIV

BLADDER AND PROSTATE.

Methods of Examining the Bladder—When a patient presents himself complaining of increased frequency of micturition and other evidences suggestive of chronic disease of the bladder, a systematic examination of the individual and his urinary passages must always be instituted. The history of the case, the character of the symptoms, and the condition of the urine, are carefully gone into. An examination of the bladder should then be made. (1) The patient is laid on a couch, and the lower part of the abdomen uncovered. The hypogastrium is examined by inspection, palpation, and percussion, so as to ascertain whether or not the bladder is distended, or if any abnormal resistance can be felt, either from thickening of the wall or the presence of a tumour. (2) The finger is inserted into the rectum, or, in the female, into the vagina, so as to enable the condition of the posterior vesical wall to be investigated. Enlargement of the prostate or of the vesiculæ seminales can also be detected in this way. (3) A sound is then passed according to the method described at p. 1413, and the anterior of the viscus explored, by this means a calculus may be detected, and even sometimes a tumour, as also a rough and irregular condition of the mucous membrane. (4) The patient may then be asked to void urine, after which a rubber catheter may be introduced, and the amount, if any, of residual urine estimated. (5) As mentioned elsewhere, Bigelow's evacuator is useful, not only to wash out the bladder, but also to detect the presence of very small calculi which the sound may have missed. (6) Of recent years the chief means of examining the interior of the bladder is the *cystoscope*. This consists of a straight tube with a short end bent at an angle, in which an electric lamp is placed, the wires leading to it being carried within the tube. A small window covered with glass is situated close to the angle, and a prism is here inserted in such a manner that, when the surgeon looks through an eyepiece placed at the end of the instrument, he is able to see the portion of the vesical wall illuminated by the electric lamp. To use it the bladder must be previously washed out after some local anæsthetic (novocain) has been introduced into the urethra. In those cases where the bladder is very irritable a spinal anæsthetic is given. About 10 or 12 ounces of boric acid lotion or clear water should be present in the bladder, so as to prevent the vesical wall from being injured by the instrument, which always becomes hot after the lamp has been used for some time. Considerable practice is needed for any useful information to be gained by the aid of this instrument, but in skilled hands much may be learnt as to the condition of the mucous membrane (see Plate XXIX.) Slight modifi-

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cations of the instrument permit of the passage of a solid bougie or small catheter, which can be inserted into the ureteral orifice and up the ureter (7) Finally, in cases where great irritability of the bladder exists in spite of treatment and its presence cannot be explained an exploratory suprapubic cystotomy is justifiable

A distended bladder constitutes a rounded swelling which projects above the symphysis pubis and may even reach to the umbilicus in some cases The swelling may be visible to the naked eye, and is dull on percussion the dulness rising directly above the symphysis, it is quite immovable and therein differs from many ovarian and uterine tumours Bimanual examination *per vaginam* or *per rectum* should

at once indicate its nature, and when at all doubtful a catheter should be introduced

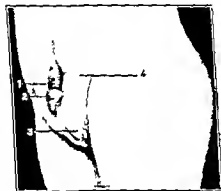


FIG. 832.—ECTOPIA VESICÆ

- 1 Exposed mucous membrane of posterior wall of bladder 2 glans penis drawn up to cover lower part of vesical mucosa and orifices of the ureters 3 scrotum 4 projection of pubic ramus

Congenital Affections of the Bladder — 1 Ectopia Vesicæ, or Extroversion of the Bladder, is the term employed to denote total absence of the anterior wall of the bladder and of the lower portion of the abdominal parietes as a result of which the mucous membrane of the posterior vesical wall is exposed and rendered somewhat prominent by the pressure from behind of the abdominal contents (Fig 832, 1) This surface is usually not much more than an inch in diameter in an infant and is often irregular and covered with papilliform processes, the

orifices of the ureters are easily recognized below, urine being occasionally emitted from them in forcible jets The condition is necessarily one of the greatest discomfort not only from the constant dribbling of urine causing excoriation and eczema of the thighs and surrounding parts but also from the pain and irritation due to friction of the clothes against the exposed mucous membrane The symphysis pubis is always absent and the horizontal ramus of the pubic arch terminates on either side in the inguinal region (4) The innominate bones are usually rotated outwards and the sacrum is convex anteriorly from side to side instead of being concave In consequence of this pelvic malformation the patient's gait and powers of progression are considerably impaired The penis (2), is cleft, and in a condition of complete epispadias it is drawn upwards and backwards over the trigone, so that it requires pulling down to expose the ureteral orifices The testes are often found in the inguinal canal or if in the scrotum are accompanied by congenital herniæ No umbilicus is present The

PLATE XXIX

FIG 1 —CYSTIC CYSTITIS

The cysts occur in a healthy or slightly inflamed bladder they are discrete and not confluent. Most commonly found as the result of chronic inflammation in parous elderly females. Not to be confused with bullous cystitis.

FIG 2 —EDEMA (BULLOUS CYSTITIS)

The bullae are confluent and hyperæmic and less translucent than the cysts of cystic cystitis found in cases of tuberculosis and carcinoma and after radium treatment. (From a case of carcinoma vesicæ.)

FIG 3 —TUBERCULOSIS

A slightly retracted right ureter is seen with a tuberculous ulcer above. The white shining nodule is a tubercle.

FIG 4 —PYONEPHROSIS

Thick pus is exuding from the orifice of an inflamed ureter. The bladder around shares in the hyperæmia.

FIG 5 —PAPILLOMA

Note a gradual change from long slender fern-like processes to a shorter more fleshy type (an early stage in malignant change). The star of pale radiating striae is a scar resulting from fulguration of a papilloma. The present growth is a recurrence six months after treatment by fulguration.

FIG 6.—PROSTATE

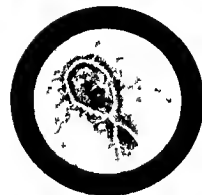
A view of an enlarged middle lobe seen in the mid line on the floor the bladder is seen in the distance over the hull of the prostate. This type is suitable for trans-urethral resection.



1



2



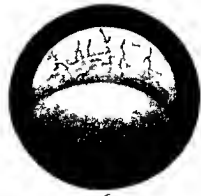
3



4



5



6

Cystoscopic appearances of pathological conditions of the Bladder

condition is due to impaired development of the anterior wall of the allantois and the lower segment of the abdominal parietes. At birth the lower portion of the umbilical cord is expanded over the raw surface, constituting the anterior vesical wall. When the cord separates the posterior vesical wall is necessarily exposed.

The Treatment of this distressing malformation is most unsatisfactory, and hence in the majority of the cases the application of a urinal has been recommended, although the instruments hitherto devised are not particularly efficient. Although various operative measures have been practised in the past, the only one which requires mention is implantation of the ureters into the large bowel. The ureters are implanted into the sigmoid, one above the other. One ureter should be implanted at a time, and some months allowed to elapse between the operations. This method has given better results, both in this country and in America (Mayo clinic), than transplanting the whole trigone of the bladder with the ureters into the sigmoid. Turner* has recorded seventeen personal cases with four deaths directly due to the operation, which is very satisfactory considering its severity and delicacy.

2 An Umbilical Urinary Fistula is sometimes met with as a result of imperfect closure of the urachus.

3 Occasionally in cases of malformation of the rectum the Primitive Cloacal Condition may in part persist (see p. 1336).

Traumatic Affections of the Bladder.—Rupture may be produced in several ways. (1) It may be due to direct violence applied to the lower part of the abdomen, especially when the viscus is distended. (2) It may complicate a fracture of the pelvis, either as a direct result of the violence, or from penetration of a spicule of bone from the os pubis. (3) The bladder may be opened by a penetrating wound. (4) Apart from traumatic lesions, rupture may occur from simple over distension especially if destructive ulceration of its walls is present, or it may follow ulceration of a sacculæ if it contains a phosphatic concretion.

Rupture of the bladder is divided into two main classes, according to whether or not the peritoneal cavity is opened. The peritoneum covers the upper and back part of the viscus, being reflected anteriorly along the urachus, laterally along the obliterated hypogastric arteries, and posteriorly on to the rectum.

Intraperitoneal Rupture involves the posterior superior portions of the viscus, and is the variety most frequently met with. The symptoms produced are severe shock, associated with hypogastric pain of a burning nature. The patient experiences a constant desire to micturate, but, as a rule, nothing is passed, except perhaps a little blood. Peritonitis soon follows, running a rapidly fatal course, especially if efficient treatment is not adopted. On passing a catheter the bladder is usually found empty, or possibly a little blood-stained urine may be withdrawn, if, however, the instrument happens to be insinuated through the rupture into the peritoneal cavity, a considerable quantity of blood stained urine can be drawn off, and the point of the catheter may be felt under the anterior abdominal wall. A useful

* G. Grey Turner, *Brit Journ Surgery*, vol. xvii, No. 65, 1929 p. 114.

diagnostic sign consists in injecting a measured amount of boric acid lotion into the bladder, and noting how much of it returns, when a rupture exists some considerable discrepancy will probably be noted between the two quantities, this test cannot, however, always be relied on.

The Treatment of these cases consists in immediate laparotomy; the fluid within the peritoneal sac is aspirated or mopped up by swabs, and the wound in the bladder clearly demonstrated, preferably with the patient in the Trendelenburg position, which must not, however, be adopted until the urine and inflammatory effusion have been removed. The rent is carefully closed by means of a row of Lembert sutures, not involving the mucous membrane, which should always extend a little beyond each extremity of the wound. It is safer to drain the bladder by a rubber tube extraperitoneally than to rely on drainage by an indwelling catheter. The peritoneum should also be drained and the abdomen closed in the usual way.

Extraperitoneal Rupture of the bladder involves its anterior wall or base. The urine finds its way into the pelvic cellular tissue, and gives rise to a most virulent form of suppurative pelvic cellulitis, which is usually fatal from toxæmia or pyæmia. Abscesses generally point either above the pelvic brim or in the perineum. The treatment consists in free incisions into the area of extravasation, and a large suprapubic tube should be introduced into the bladder, through which the urine can escape freely for a time. As soon as the tissues are sealed off by the development of granulations, the tube may be withdrawn. The prognosis largely depends on the condition of the urine, whether healthy or contaminated with bacteria, and on the length of time it is allowed to remain in contact with the tissues.

Foreign Bodies introduced into the bladder from without are of various natures, such as portions of catheters, or bougies, pins, etc. They give rise to symptoms of chronic cystitis, and usually become encrusted with phosphatic deposit. They should be removed as early as possible with a lithotrite, but if of large size or thickly covered with phosphates must be treated by suprapubic cystotomy.

Cystitis may be due to a great variety of causes, but is always in essence of bacterial origin. Many different forms of bacteria may be found, but those most usually present are ordinary pyococci and the *B. coli*. Neither of these has any power of decomposing urea and setting free ammonia; this change is generally brought about by the *Micrococcus ureæ* which is probably identical with *Staphylococcus epidermidis albus*. The *B. coli* grows badly in alkaline media, and hence if present in a pure infection the urine remains acid, though stale and offensive to the smell. The methods of invasion of the bladder are diverse: (1) Bacteria may reach the viscus from above, either owing to a suppurative lesion of the kidney or its pelvis, or escaping into the urine from the blood. (2) They may travel up the urethra. This is a matter of no difficulty in the short and comparatively large urethra of a woman, and hence cystitis is frequently associated with vulvitis or is seen after labour. In girls a pure bacillary cystitis with acid urine is not uncommon, and is probably secondary to a vulvo-vaginitis, which arises from

contamination of the vulva with the faeces where cleanliness is neglected. In the male sex, infection from the urethra is unusual unless urethritis has previously existed or some irritation, due to the passage of instruments. Even if they are carefully sterilized, mucus is liable to form and cling about the urethral wall and along this bacteria can find their way. Naturally the introduction of an unsterilized dirty instrument may suffice to cause cystitis. (3) Bacteria can invade the bladder from surrounding organs, being transmitted by lymphatic dissemination. Thus an injury of the rectum may easily lead to cystitis.

The mere presence of bacteria in the bladder is, however, not sufficient as a rule to determine an attack of cystitis. Large quantities of pus are frequently discharged from the kidney through the bladder, and that over lengthy periods, and yet no inflammatory reaction follows. Some *local predisposing factor* must be added in order to excite their activity, and amongst the most favourable are the following: (i) Congestion of the mucous membrane, determined by exposure to cold, this is peculiarly liable to occur in gouty individuals, and, indeed, there are people who 'take cold' in their bladders instead of developing a nasal or bronchial catarrh. (ii) Injury, as by the presence of a foreign body, a calculus, or rough handling during an operation, may serve to render bacteria active and virulent. (iii) One of the most important causes is retention of urine, from whatever cause it is due, *e.g.* enlarged prostate, stricture, etc. The bacteria develop and decompose the urine, rendering it offensive and ammoniacal, and the toxins and irritating bodies thereby produced affect the vesical mucosa. (iv) The presence of irritants in the urine may determine cystitis, as also pyelitis, *e.g.* after the absorption of cantharides. Other drugs may light up bacterial activity in some predisposed individuals, *e.g.* copaiba or cubebs. (v) Loss of nervous control is a most important predisposing factor, and comes prominently into play in spinal injuries. The greatest difficulty is experienced in protecting such patients, and even effective purification of penis, hands, and catheter, and the application of a sterilized dressing to the organ, after a catheter has been used, may not suffice to prevent an outbreak of cystitis, which is due to infection from the kidney or rectum. In these cases the disease always runs a virulent course, and is likely to kill the patient by extension up the ureter.

Pathological Anatomy.—In acute cases the mucous membrane of the bladder becomes congested and thickened, the epithelium is shed, mucus is excreted, and is soon transformed into muco-pus, which may be extremely viscid, and develops in large quantities. Ulceration of the bladder wall may follow, or even sloughing, in the worst cases the whole of the mucous lining may necrose, and be cast off as a slough. Sometimes a membranous form of inflammation occurs, the patient frequently passing flakes of some size, which on examination are found to be chiefly composed of fibrin.

In chronic cases the mucous membrane is thickened and congested, the superficial veins dilated and even varicose, whilst ulceration is not uncommon. The continued repetition of the act of micturition leads to hypertrophy of the bladder wall, which becomes thickened and

fasciculated, this effect is of course most marked when the cystitis is associated with obstruction to the outflow of urine. The mucous membrane may protrude outwards between the muscular fasciculi, giving rise to pouch like sacculi in which phosphatic concretions are sometimes formed and the retained urine undergoes decomposition. Perforative ulceration occasionally follows originating a fatal peritonitis or pelvic cellulitis from extravasation of urine. The contracted state of the bladder and the overgrowth of its muscular substance lead to compression of the openings of the ureters, hydronephrosis being thus induced. A plug of viscid mucus often finds its way into the ureteral orifice, and by becoming infected with bacteria causes an extension of the infective mischief to the kidney.

The Symptoms of Acute Cystitis consist in pain referred to the perineum and hypogastrium together with tenderness on pressure over the symphysis pubis. This is accompanied by extreme irritability of the bladder, frequent efforts of a painful and spasmodic nature being made to pass water (strangury), but little urine is voided at a time for as soon as any amount has collected it is ejected forcibly. It generally contains blood and pus, and teems with bacteria. Some amount of fever is generally noted, as also vomiting, and tenesmus may be induced as a result of the proximity of the rectum to the inflamed bladder. The usual termination of the case is in resolution but sometimes chronic irritability may persist. In rare instances the inflammation is of such a virulent nature as to cause death. The urine in these cases is often exceedingly foul, and the fatal issue is due to exhaustion, peritonitis, suppurative pyonephrosis, or even acute toxæmia. In some patients however, when the inflammation is concentrated at the neck of the bladder, retention, distension, and atony may ensue.

Treatment—The patient should be kept in a warm atmosphere, and preferably in bed with fomentations applied to the lower part of the abdomen. hot hip-baths twice daily, maintained for some time, are very advantageous. The diet should be restricted to fluid, and the patient encouraged to partake freely of barley water and other bland liquids. Alkalies and hyoscyamus may be administered, and morphia and belladonna suppositories are useful to allay the pain and irritability. As a rule no instrument should be passed during the acute stage unless retention is present, but if the urine becomes very foul the bladder may be gently washed out. Urinary antiseptics such as hexamine (5 to 10 grains three or four times a day), administered by the mouth may do good, in the intervals between the doses acid phosphate of soda should also be given but is usually better reserved for the subsiding stages of the attack.

Chronic Cystitis is much more common than the acute variety, and is usually associated with some irritation of the walls of the viscus, as from calculi tumours foreign bodies, tuberculous ulceration or retention and decomposition of urine especially if associated with obstruction to the outflow, as by a stricture or enlarged prostate. It may also follow acute cystitis.

The Symptoms are those of irritability of the bladder, the patient

constantly desiring to pass water, and having to rise at night, perhaps several times, for this purpose. The urine becomes turbid, and on standing, deposits a variable amount of mucus or muco-pus, mixed with epithelial cells, crystals of triple phosphate and a granular sediment of phosphate of lime. It is usually alkaline (unless due to a pure infection with the *B. coli*), perhaps foul smelling and ammoniacal containing an abundance of micro organisms. There is often but little pain, though when a calculus exists or the neck of the bladder is ulcerated, this may become a prominent symptom. The patient's general health is not at first affected but if the symptoms persist it soon becomes impaired—partly from the absorption of septic products from the bladder, and partly from the want of rest and sleep arising from nocturnal disturbance—and this may be so marked as to lead to fatal exhaustion. In other cases the inflammation may spread from the bladder along the ureters to the kidneys, and the phenomena of septic pyelonephritis manifest themselves.

The Diagnosis of chronic cystitis is readily made from the characteristic symptoms of irritation of the bladder and the condition of the urine, but considerable difficulty may be experienced in determining its cause. In investigating a case, not only must the character of its onset be considered, but also the general history of the patient. A thorough examination of the lower urinary passages must always be instituted and the urine examined microscopically and bacteriologically. The passage of a catheter or sound will generally detect any obstruction located in the urethra, whilst the bladder is also examined by the cystoscope and other methods described at p 1397.

The Treatment of chronic cystitis is naturally directed towards its cause, if this can be discovered, thus, calculi or foreign bodies should be removed, and a stricture dilated. In most cases, even where the cause is not apparent, great benefit will be derived from washing out the bladder.

The bladder is irrigated by mild antiseptic lotions. Various solutions are employed for this purpose, but perhaps the most useful are weak Condy's fluid, sanitas (1 in 10), boric acid (20 grains to 1 ounce), or nitrate of silver ($\frac{1}{2}$ grain to 1 ounce), and they may be used alternately with advantage. Acetic acid $\frac{1}{2}$ per cent is valuable in cases of foul alkaline cystitis such as is associated with vesical diverticulum. The frequency with which the injections are made must vary with the severity of the symptoms, it is not often necessary to perform the operation more than once or twice a day. Of course, the most stringent precautions must be taken as to sterilization of the patient's penis, of the surgeon's hand, and of the instruments employed.

At the same time that this local treatment is being adopted, the patient's general habits of life must be regulated. The diet should be bland and unstimulating, alcohol is better avoided, but if essential for other reasons, well-diluted gin or whisky may be given. Tea and coffee should be prohibited, and milk should be given freely, together with barley water and some mild alkaline water—such as that derived from Contrexeville. Hexamine, 10 grains three times a day, is the most

useful urinary antiseptic, and to be effective the urine should be acidified by adequate doses of acid sodium phosphate, a more powerful acidifier of the urine is ammonium chloride, gr xx t d s. This should alternate with an alkaline mixture containing tincture of hyoscyamus and infusion of buchu.

Vaccine treatment should be employed if the *B. coli* is the active organism, and is of some help. The patient may remain apparently well and yet the urine teems with bacteria, and occasional bouts of cystitis occur, which must be treated by alkaline drugs and by washing out the bladder either with Condy's fluid or with a very dilute solution of nitrate of silver.

In cases which do not improve and when the patient is becoming exhausted by toxic absorption, want of sleep, etc., it is essential to put the parts at rest and to secure rest for the patient by draining the bladder.

Suprapubic Cystotomy is a simple operation with no special risks and gives good results. The procedure adopted is as for suprapubic lithotomy. A rubber tube with two or three openings at the distal end is placed in the cavity, and the bladder wall stitched closely around possibly one fine catgut stitch may secure it in position to the bladder wall so as to keep it from slipping out. The wound in the abdominal parietes, purified by alcohol, is closed around the tube (not too tight) by through-and-through silkworm gut stitches, and a dressing is applied. A rubber tube sufficiently long to pass into a vessel containing water placed on a level lower than that of the bladder is united to the drainage-tube by a glass connection. As the urine is secreted it passes up the tube and soon overflows, establishing a syphon connection as soon as the air is expelled. Possibly a more satisfactory method is to employ suction drainage as suggested by Cathcart, the bladder drainage-tube is connected by a T glass connection with a tube along which is kept running a stream of water, this by its negative pressure sucks out the urine from the bladder, which is thereby kept empty and at rest.

Diverticula of the bladder may be of congenital origin, and are usually observed either at the apex, and then probably due to imperfect closure of the allantoic sac, or at the base just above the trigone, and possibly in close relation to one of the ureteral orifices. This latter may be due to some abnormality in the division of the primitive cloaca into bladder and bowel. These conditions are usually observed in young males and arise apart from any urinary obstruction. They are associated with irregularities in the action of micturition, and are likely to be recognized on cystoscopic examinations for the same. The exact relation to ureters, etc., can be determined by radiography after an injection of sodium iodide, and possibly by the passage subsequently of a ureteral catheter. If the proceeding appears to be at all feasible excision of the cyst can be undertaken, and is usually successful.

Quite distinct from these congenital diverticula are the acquired Sacculi, which develop in consequence of hypertrophy of the muscular fasciculi of the bladder wall in cases where there is some obstruction

to the urinary overflow. In diverticula the whole bladder wall is represented in the earlier stages, mucous membrane and muscular fibres being found in sacculi only the mucous membrane is protruded as a hernial pouch between the muscular bundles. These gradually increase in size, and are to be found most commonly on the upper part of the bladder. Urine stagnates in them and undergoes decomposition, the walls may become inflamed and even ulcerate or perforate, a calculus may lodge therein, and increasing by fresh deposits of the constituent salts, may finally project into the bladder cavity, being held in position by a narrow neck. Occasionally they become so large that they are drawn down into the sac of a hernia. Exact diagnosis is made by cystoscopy and radiography after an injection of sodium iodide, and removal is the ideal treatment, where this is not possible enlargement of the opening into the bladder to allow adequate drainage may be tried, or invagination of the diverticulum.

Tuberculous Disease of the Bladder is almost invariably secondary, extending from the kidney, prostate, or testicle. It is much more common in men than in women, and is most frequently seen in young adults. It commences in the submucous tissue as a deposit of milary tubercle (Plate XXIX, Fig. 3), which caseates and suppurates, breaking down, and giving rise to ulcers with undermined edges, these are rarely of large size at first are usually multiple, and situated in or near the trigone. The Symptoms are those of chronic cystitis and hæmaturia, the irritability of the viscus being very marked. The diagnosis is made by demonstrating the bacillus of tubercle in the urine, and by the cystoscope. The course of the case is unfavourable, the ulcers increasing in size, and death resulting from exhaustion, general infection, phthisis, or renal complication.

Treatment.—The case is usually treated for some time as one of chronic cystitis before its nature as a tuberculous affection is ascertained. In the milder cases it will suffice to attend to the general health and hygiene of the individual, and to wash out the bladder with some antiseptic two or three times a week, leaving a drachm or two of a 5 per cent solution of iodoform in liquid paraffin within the viscus. Injections of tuberculin have been found decidedly valuable in this condition, and should be continued for over a year. In more advanced cases, where the patient's life is a misery owing to continual pain, the ureters may be transplanted from the bladder to the skin on the anterior abdominal wall, or more recently relief of pain and frequency has been obtained by division of the presacral nerve.

Very similar symptoms may be induced by the presence of a **Simple Ulcer of the Bladder**, which, according to Fenwick, occurs not unfrequently. It is usually single, and situated near the neck or trigone, giving rise to great irritability of the viscus and hæmaturia, although the urine remains clear. The diagnosis is best made by the cystoscope. Phosphatic deposits sometimes form over the ulcerated surface, and may suggest the existence of a stone. Treatment consists in washing out the bladder with lactic acid ($\frac{1}{2}$ to 3 per cent), or in cauterizing the base of the sore through an operating cystoscope.

Tumours of the Bladder—New growths from the vesical wall are not very uncommon they may be simple or malignant

Simple Tumours occur in the form of fibroma, myoma and myxoma but that most often seen is the **Papillomatous or Villous Tumour**, which appears as a soft flocculent mass usually situated near the trigone and close to the opening of one of the ureters (Fig 833). The floating tufts or villous processes consist of an extremely delicate connective tissue covered with a layer or two of epithelium similar to that lining the bladder and traversed by bloodvessels. Occasionally the growths have a narrow base and are pedunculated but more frequently are sessile and then the base is liable to be infiltrated and a cancerous



FIG 833.—VILLOUS TUMOUR OF THE BLADDER (FROM KING'S COLLEGE HOSPITAL MUSEUM)

element is by no means uncommon. They may be single or may multiply rapidly and spread all over the bladder by infection from the primary growth (Plate XXIX Fig 5).

The **Symptoms** are those of recurrent hæmorrhage the blood being of a bright red colour followed later on by irritability of the bladder. At first the hæmorrhage is intermittent considerable intervals occurring between the attacks but subsequently it becomes more continuous. The irritability of the bladder is generally induced by chronic cystitis and when the urine has undergone alkaline changes there is a copious exudation of ropy mucus which mixing with the urine causes considerable difficulty in micturition leading in some cases to strangury.

The urine may also contain portions of the tumour which have been set free, and occasionally, if situated near the neck of the bladder, some of the fimbriated ends may be swept into the urethral orifice, and interfere with micturition. In the same way the opening of one or both ureters may be encroached upon, leading to hydronephrosis. On examination of the bladder with a sound, nothing definite can be detected, unless the surface of the growth becomes encrusted with phosphates, and *no abnormality is noticed on rectal examination*. Occasionally a small portion of the growth may be caught in the eye of a catheter.

Prognosis.—A considerable element of uncertainty generally exists about these cases, since, although single growths with a well defined pedicle are usually free from recurrence after removal, there is always a possibility of the implantation of living cells in the mucous membrane, giving rise to multiple growths, the removal of which may be impossible, and causing death from hæmorrhage or back pressure. Moreover it is often impossible to be certain that the base of the tumour is free from malignancy.

Sarcoma of the bladder is an uncommon disease, more often seen in children than in adults. In the former it gives rise to multiple polypoid growths, in the latter it is often single and sessile. The tumour grows rapidly, and may attain considerable dimensions, spreading outside the bladder, and even invading the pelvic bones. Lymphatic glands may be implicated at an early date.

Cancer of the bladder is more common in men than in women, and may originate in the viscus, or may spread to it from the rectum or neighbouring organs. In the former case, the growth is generally a squamous epithelioma, in the latter, its nature is, of course, similar to that of the primary disease, thus, when secondary to rectal cancer, the tumour is of a columnar type. Most frequently the affection commences in the posterior wall above the trigone, extending forwards to the neck of the bladder. The growth is sometimes superficial, projecting into the vesical cavity as a soft spongy mass, which does not ulcerate early, or invade the muscular walls till late, but more frequently the neoplasm extends into and infiltrates the walls, whilst marked ulceration is also present (Fig 834), the raw surface often becoming coated in places with a phosphatic deposit. A cancerous growth in the bladder is always more or less likely to become papillated and, indeed, every type of transformation from the simple villous growth to the malignant form can be demonstrated.

The **Symptoms** vary somewhat in these two forms, although the conspicuous features of each are hæmaturia and irritability of the bladder. In the slowly growing superficial variety, the tumour often attains a considerable size before causing any trouble, beyond possibly some slight irritability of the bladder. A severe attack of hæmaturia, unaccompanied by pain, is usually the first symptom of importance, and may be induced by some injury which causes a crack or fissure in the growth. This painless hæmaturia closely simulates the early symptoms of a simple villous tumour, but is more persistent, and yields less readily to treatment. After one or more of such prolonged attacks cystitis

follows and the subsequent history resembles that of the harder and more rapidly growing infiltrating tumours. In these latter the symptoms of vesical irritability precede those of hæmaturia. Dysuria and severe pain referred to the bladder and perineum are complained of and the urine early becomes alkaline and putrescent shreds of the growth may also be found in the urine on microscopic examination. If the tumour involves the internal meatus micturition may be considerably impaired if the orifices of the ureters are obstructed hydro-nephrosis results. On passing a sound the tumour can be detected as an irregular mass projecting into the bladder whilst the posterior

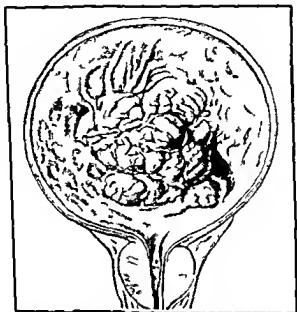


FIG. 834.—CANCER OF THE BLADDER. (FROM ROYAL COLLEGE OF SURGEONS MUSEUM)

vesical wall may be felt *per rectum* to be hard and resistant its ulcerated surface may also be seen with the cystoscope.

The course of the case is similar to that of a somewhat rapidly growing carcinoma leading to early and marked cachexia increased by the sleeplessness resulting from the vesical irritation. Secondary deposits are found in the viscera and lumbar glands whilst perforation of the wall may occasionally follow causing urinary extravasation septic cellulitis and death. Another most distressing complication is the establishment of a recto-vesical fistula through which the urine makes its way into the rectum thus intensifying the sufferings of the patient.

The Diagnosis of a vesical tumour can only be made with certainty

by the cystoscope, and by discovering fragments of its substance in the urine. Whenever hæmorrhage is associated with marked vesical irritability, and cannot otherwise be explained, a tumour of the bladder may be suspected, and cystoscopy must be undertaken. In this viscus, as in others, the only hope of curing malignant disease lies in early operation, and if the practitioner waits until the diagnosis is assured by the symptoms, the patient's case is probably hopeless. Early cystoscopy is all important.

In simple papilloma and the superficial type of epithelioma, hæmorrhage precedes the irritability, but whilst it is usually impossible to detect the villous growth either by examination with the sound or from the rectum a fungating malignant growth may sometimes be recognized by the sound. The infiltrating type of malignant disease, on the other hand, pain and dysuria always precede the bleeding for a considerable interval whilst definite evidence of the existence of the growth can usually be made out, both by the sound and on rectal examination. A worn and exhausted appearance must not be looked on as necessarily the outcome of advanced cancerous cachexia, since the loss of rest and sleep due to chronic vesical irritability can of itself lead to a somewhat similar condition.

Treatment of Villous Tumours of the Bladder.—In the early stages, when the diagnosis of a tumour has not been confirmed, the hæmaturia may be treated with ordinary hæmostatic remedies, such as a mixture containing dilute sulphuric acid and ergot, or turpentine administered in capsules (10 minims three times a day).

When once a diagnosis has been established, active operative treatment is essential. Two plans are available (1) Destruction by **Diathermy**. In this plan special apparatus is required. A cystoscope for catheterizing the ureters is employed, but instead of the catheter, a flexible sound with a fine rounded metallic end which serves as an electrode is passed, the remainder being carefully insulated. The other terminal of the current is attached to a pad wetted with salt solution placed under the patient's back. The current employed is of high potential, gradually increased. The metallic terminal under the control of the eye is approached to one portion of the growth after another, and as it touches and makes contact with it, the growth turns white and shrivels up. This method of treatment is troublesome, but excellent, when available. (2) When diathermy is not available nor desirable, villous growth must be treated by *excision* through a suprapubic cystotomy. The sessile type is less effectively treated than the pedunculated, and, indeed, it is a question whether it is not always wiser to deal with such cases from the first by excision. Of course, the difficulty lies in recognizing the absence of a pedicle. After opening and exploring the bladder, a self retaining retractor is introduced, and the interior illuminated by a forehead electric lamp, or by bulbs actually incorporated in the retractor. If more room is required, one of the rectus muscles may be cut across about 1½ inches above its insertion, and the viscus can thus be freely opened. The larger growths are removed by dividing the mucous membrane around them and cutting them away after ligaturing or cauterizing the base,

the incision in the mucous membrane should be closed by fine catgut if possible. Smaller growths may be destroyed by the galvano-cautery. The finger of an assistant in the rectum can press forward the posterior wall and give effective help. Where the growths are very extensive and complete removal almost impracticable radium may be of considerable value. A suitable quantity in a metal filter can be placed in the terminal portion of a rubber catheter and left in position for twelve or twenty four hours as may be thought desirable.

For malignant disease of the bladder partial or complete cystectomy may be possible. Partial Cystectomy consists in removal of the whole thickness of the vesical wall involved by the growth and according

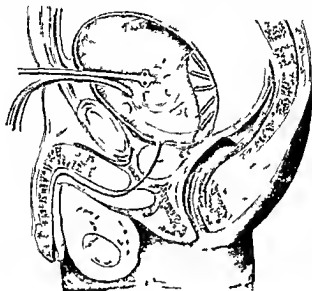


FIG 835 SUPRACUTANEOUS METHOD OF IRRADIATION FOR CARCINOMA OF THE BLADDER

to its location this may involve opening the peritoneal cavity or not. The bladder is exposed as described above and the peritoneum is detached up to and beyond the growth which is cut away the solution of continuity in the wall being made good by careful suturing with catgut. If the ureter is involved in this resection it should be divided through a healthy spot and reimplanted in the bladder. Complete Cystectomy has been undertaken for extensive malignant disease but it is more than doubtful whether it is ever justifiable for the disease almost certainly involves both ureters and this is practically always associated with changes in both kidneys which render operative treatment most dangerous. The actual results of operations for cancer of the bladder are extremely disappointing.

When removal is impracticable the growth may be treated with *radium* either by the introduction of radon seeds through an operating cystoscope or by the open cystostomy method. The latter is the method of choice. The bladder is opened suprapubically and radium needles are introduced into and around the growth (Fig 835). Small radium needles containing 0.6 mg of radium with threads attached are passed through a small rubber tube into the bladder. A self-retaining catheter is also placed in the bladder and the suprapubic wound closed. The radium needles together with the tube are removed after a week. It must be remembered that radium treatment is contra indicated whenever there is bilateral kidney infection.

Stone in the Bladder

Varieties — A vesical calculus may be formed of almost any of the urinary deposits commonly met with and each has its own special characteristics.

(a) The *uric acid* calculus is usually an oval flattened body of considerable density with a smooth or slightly nodular surface and of a nut brown colour. On section it is distinctly laminated and it may be surrounded by a crust of phosphatic material.

(b) The *urate of ammonium* calculus is of very similar structure but of a lighter colour and the lamination is less distinct.

(c) The *oxalate of lime* or mulberry calculus is a rough irregular body sometimes evenly nodular but not infrequently tuberculated or even spiculated. It is extremely hard and dense laminated and of a dark red brown colour or sometimes black owing to admixture with blood. It is rarely of great size on account of the irritation caused by its presence and its slowness of growth.

(d) A pure *phosphatic* calculus is very uncommon but any stone or foreign body is certain to become coated with a phosphatic deposit when chronic cystitis has resulted in alkaline decomposition of the urine. Occasionally concretions of a similar nature form spontaneously in saccules of the bladder these are white and chalky in appearance friable in consistency with no evidence or but little of lamination and on removal are exceedingly offensive they consist of a mixture of the triple ammonio-magnesian phosphate and phosphate of lime. Less commonly an excess of the triple phosphate is present if in the proportion of two parts of the latter to one of phosphate of lime, a laminated and somewhat denser calculus is produced which is sometimes termed a *fusible calculus* owing to the fact that it fuses to a bead under the blowpipe flame. Occasionally a phosphate of lime calculus occurs in the upper urinary passages e.g. the pelvis of the kidney, and has a crystalline appearance on drying.

(e) *Cystine* forms the base of a rare calculus which is of a yellowish green colour and waxy appearance.

(f) *Xanthine* or xanthic oxide occurs very exceptionally as a calculus of a reddish colour.

An *encysted* calculus is one which develops in a saccule of the bladder. It may consist of any of the above substances and is due to a small

stone finding its way into a sacculæ and being arrested there. It grows by gradual accretion of new calculus material and after a time projects into the vesical cavity. In such a calculus the large intra-vesical portion is separated from the encysted part by a narrow neck. Ulceration of the sac wall is not unlikely to follow and extravasation of urine.

Structure of a Calculus—A calculus usually consists of the following parts: (1) The nucleus which may be formed by a portion of blood clot inspissated mucus a renal calculus or some foreign substance introduced from without. (2) The body which consists of superposed layers of uric acid or oxalate of lime or of whatever substance the stone is composed not infrequently the composition of adjacent laminae differs leading to what is known as an *alternating calculus*. Each lamina consists of myriads of minute crystals held together by vesical mucus with which a certain amount of phosphatic material is often mixed whilst layers of pure phosphatic deposit may be interposed. (3) The crust consists of a variable amount of soft friable phosphatic material the quantity of which is the measure of the degree of chronic cystitis originated by the calculus in some cases it is entirely absent.

The Number of calculi present in a bladder varies greatly. Some times there is only one occasionally a considerable number counted perhaps by hundreds may exist in such circumstances they are never of great size. Multiple calculi are not infrequently faceted as a result of mutual friction.

The Causes of vesical calculus must be looked for in some of those constitutional conditions already described as predisposing to lithiasis or oxaluria. They are not uncommon in children during the first decade of life especially amongst the lower classes. It diminishes in frequency from childhood to the age of twenty five and then gradually increases until it is relatively common in elderly men. The condition is comparatively rare in women owing to the fact that the shortness and large size of the urethra allow small calculi to be much more readily passed. Possibly the character of the drinking water or the amount imbibed is a matter of importance as indicated by the fact that the occurrence of calculus is very unequally distributed in different parts of the same country thus in England it is most frequently met with in the Eastern Counties. It is also very common in India and Arabia a fact which may possibly be explained by the large amount of fluid withdrawn from the body by perspiration and by vitamin deficiency due to the highly starchy nature of the diet.

Symptoms—The effects produced by vesical calculi vary in different individuals according to the shape of the stone and the tolerance of the mucous membrane. In children and young adults where the parts are very sensitive even a smooth calculus gives rise to severe symptoms but old men often tolerate a large stone without much inconvenience *ceteris paribus* an oxalate of lime calculus is always more irritating than one composed of uric acid. The classical symptoms of a vesical calculus may be preceded by a history of the patient having passed gravel for a long time or by an attack of renal colic

on the cessation of which the calculous symptoms commenced. Sometimes the vesical symptoms do not appear for some time after the passage of a stone into the bladder, presumably in consequence of its small size. They consist of pain in the perineum and neck of the bladder which radiates to the back and down the thighs but is especially noticed at the end of the penis immediately after micturition. The stone is then pressed down against the sensitive neck of the bladder by the contraction of its muscular walls. Increased frequency of micturition is also present, and perhaps hæmaturia of a vesical type, though this is not a prominent feature. All these phenomena are increased in severity by jolting, jumping, or any form of exercise, and hence are more marked during the day than at night. Occasionally the patient complains that the flow of urine suddenly ceases before the bladder has been completely emptied, and that some change in the position of the body is needed in order to allow him to complete the act. In addition to these characteristic symptoms, he may suffer from various phenomena secondary to the irritability of the bladder, and dependent on the straining induced by the calculus. Thus, tenesmus may be produced by sympathetic irritability of the rectum, especially in children, and a hernia be thereby caused, priapism, too, is not uncommon.

The symptoms are somewhat modified in *children*, leading to irritability of the bladder, as evidenced by wetting of their clothes and of their beds at night, and pulling at the prepuce and penis. These manifestations are very similar to those caused by a tight foreskin, with which condition, indeed, a stone is often associated.

The actual **Diagnosis** of vesical calculus can be made by sounding, radiography, or cystoscopy. (1) In order to examine a patient by *sounding*, he is laid on a couch with the head low, and the buttocks raised on a pillow placed beneath them. The bladder should always contain a few ounces of fluid, so as to obliterate any folds produced by laxity of the mucous membrane, as well as to facilitate the introduction of the instrument. A sterilized sound of suitable size, warmed and lubricated by some antiseptic preparation, is then gently passed along the urethra, and the handle depressed between the separated legs so as to enable the point to enter the bladder. The handle, which should be cylindrical in shape and fluted, with the maker's name or some mark to indicate the direction of the beak, is then lightly grasped between the index finger and thumb, and rotated from side to side, whilst at the same time the whole instrument is drawn forwards or backwards in the urethra. Each side of the bladder is thus carefully investigated, and, finally, if no stone is detected, the beak is turned directly downwards, so as to examine the pouch which often forms behind a slightly enlarged prostate. The presence of a stone is recognized by a metallic click, which can be felt and even heard when the end of the instrument taps it. The character of the click is some guide to the size and density of the stone. The presence of two or more calculi is indicated by the surgeon being able to touch them on rotating the instrument alternately to each side of the middle line, or by seizing one stone with a lithotrite, and using it as a sound for the other. In

doubtful cases a still more delicate test than the sound is obtained by passing a medium sized tube of a Bigelow's evacuator and washing out the bladder. The calculi may by this means be sucked out even from sacculi and be felt to rattle against the end of the instrument when the pressure upon the indiarubber bulb is relaxed. When the



FIG. 836.—KNIAGRAM OF CALCULI IN URINARY BLADDER.

calculi are multiple and of small size they may be actually removed in this way by an examination which was only intended to be diagnostic in character. The surgeon must not forget that a hypertrophied bladder with projecting fasciculi may somewhat resemble a calculus especially when coated with phosphatic material. In some rare instances a calculus may be so completely hidden in one of the sacculi

as to render its detection impossible by these means. An encysted calculus which projects into the bladder is recognized by being always found at the same place. (2) *X ray* examination is conducted in the usual fashion care being taken to see that the rectum is empty. The tube is placed over the patient's abdomen with the rays directed downwards and backwards and the plate is behind. The calculus usually appears as a shadow immediately above the pubic ramus (Fig 836). (3) *Cystoscopy* is now used so constantly that it is needless to lay stress on its value. Indications as to the character and size of the stone can be thereby obtained and sacculi or other changes in the bladder wall observed.

Course of the Case—A patient suffering from vesical calculus is certain sooner or later to develop symptoms of chronic cystitis and septic changes in the urine are equally sure to follow. The bladder is hypertrophied and if the stone is not removed the mucous membrane becomes ulcerated and the inflammation extends to the kidneys the patient's life is thus destroyed partly by exhaustion and partly by septic or uræmic poisoning.

Treatment—At the present day only three plans are employed *viz* lithotripsy suprapubic cystotomy and very uncommonly perineal cystotomy.

Lithotripsy was formerly conducted in several stages the stone being crushed and the patient allowed to pass the debris subsequently this process was repeated at intervals of a few days until the bladder was clear. Such a proceeding took a considerable time and was exceedingly painful irksome and dangerous to the patient. The introduction of Bigelow's evacuator completely revolutionized this operation and enables it to be completed at one sitting constituting the proceeding sometimes termed *Litholapaxy*.

Operation—After anaesthesia has been induced the head is kept low and a pillow placed beneath the buttocks so as slightly to raise the pelvis. The bladder is carefully washed out with some bland antiseptic such as a solution of boric acid and about 6 ounces of lotion are left within it in order not only to obliterate all folds of mucous membrane but also to facilitate the seizure of the stone and to prevent injury of the walls during the operation.

The lithotrite (Fig 837) is then introduced. The male blade slides easily up and down in a groove in the stem of the female blade and after the stone has been seized it is brought to the centre of the bladder and the blades are forcibly pressed together by a screw action brought into play by the mechanism in the handle which can be put in and out of gear at will. It is absolutely essential that the instrument should be made of well tempered steel so as to prevent any risk of breaking during the



FIG 837 —
LITHOTRITE

operation. To introduce it some skill is needed, since the curved end is short and consequently the handle must be well depressed between the legs in order that the beak may pass under the pubic arch. The position of the stone is ascertained by rotating the instrument and using it as a sound. To catch the stone, the lithotrite must be held vertically and pressed well back against the posterior wall of the bladder on separating the blades the stone by its weight falls between them. If fairly grasped the blades when screwed up crush it into several fragments each of which is subsequently dealt with in a similar fashion. If only the margin of the stone is gripped the application of screw pressure may cause it to slip away and the manoeuvre must then be carefully repeated. When the surgeon is satisfied that the fragments are sufficiently small the largest evacuator tube that can be safely introduced is passed into the bladder. To effect this it is sometimes necessary to incise the urethral orifice with a bistoury in a downward

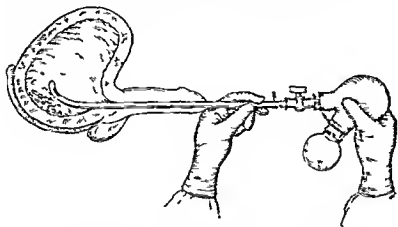


FIG 835—EVACUATOR IN POSITION IN THE BLADDER

direction. The evacuator is attached to the tube and the bladder thoroughly washed out by alternate pressure upon and relaxation of the rubber bottle (Fig 836). By this means the fragments of the stone are collected in the glass receptacle which forms part of the apparatus. The washing is continued until no more fragments are heard or felt to rattle against the end of the tube. It may be necessary to reintroduce the lithotrite in order to crush some larger portions of the calculus still remaining; the old practice of withdrawing small fragments within the grasp of a lithotrite is to be condemned. It is scarcely necessary to resound the bladder after the efficient use of the evacuator. A certain amount of bleeding is indispensable from these manipulations but it is not excessive in careful hands. Should however considerable bleeding follow the bladder is likely to become subsequently distended with clots necessitating the use of a large-eyed catheter for their removal.

After-Treatment.—The patient is placed in bed as soon as the operation is completed, and kept warm and quiet, and suitable measures must be taken to combat shock. The diet is restricted to fluids for a few days, and pain if complained of, may be relieved by a little morphia. If all goes well, he may be allowed to get up at the end of a week.

Various Sequelæ may follow this operation. *Cystitis* results partly from mechanical causes, but more frequently from the previous septic state of the mucous membrane. The symptoms are usually subacute in character, and may pass away after a few days, but if of a serious type, considerable constitutional disturbance arises, and a large amount of viscid muco-pus is excreted, the urine becoming alkaline and ammoniacal. In such a case it is absolutely essential to wash out the bladder once or twice a day, as if left to itself the condition is very liable to spread up to the ureters and may destroy the patient's life by suppurative pyelonephritis. *Atony of the bladder* is occasionally induced either by the operation or by a consequent cystitis, and is especially common in elderly individuals. It must be treated by regular and aseptic catheterism. When the patient's kidneys are already affected prior to the operation, an acute ascending pyelonephritis (p 1379) may be originated by it, perhaps leading to suppression of urine and death from uræmia.

Suprapubic Lithotomy, formerly looked on as a serious procedure with a high mortality, is now a very successful operation. The bladder is washed out and 8 or 10 ounces of lotion are left within it, the patient is then placed in the Trendelenburg position, with the pelvis raised, the intestines being thus allowed to gravitate to the postero superior part of the abdomen. A median incision is made from the top of the symphysis upwards for 2 or 3 inches, the linea alba is divided, and the retropubic cellular tissue opened up. Air finds its way into the connective tissue behind the symphysis (*cavum Retzii*), and the peritoneum is thus pressed back.

The tense rounded outline of the bladder is readily detected with the finger, and picked up and steadied on either side by a pair of tissue forceps. An opening is then made into it in the middle line from below upwards, through which the index finger is passed and the stone examined. Suitably curved lithotomy forceps are introduced, and the stone grasped and withdrawn. A careful examination is made to ascertain whether any more calculi are present, as also to investigate the size of the prostate, which if enlarged may sometimes be advisably removed at the same time. The after-treatment of the wound differs with the condition of the bladder, if it is infected, a drainage-tube is introduced, and the urine syphoned off, healing occurring by granulation in three to six weeks (see After treatment of Prostatectomy, p 1432). If the bladder is healthy and free from infection, it may be closed by catgut sutures, which only pass through the muscular and submucous coats. The external wound may be left open or closed, except at the spot where a drainage wick is passed down to the vesical wound, so as to allow exit to any urine which may accidentally leak into the wound. Often the patient can pass his water

afterwards without difficulty but if need be a catheter is passed at regular intervals or is tied in

Choice of Operation for Vesical Calculus—At the present day lithotomy has been brought to such a standard of excellence that there is no doubt as to the general rule which should be followed viz that *unless some contra indication is present all cases of vesical calculus should be treated by lithotomy*

The Contra indications to Lithotomy are as follows (1) *Conditions of the Stone* If the calculus exceeds 1½ inches in diameter it is not advisable to attempt lithotomy on account of the damage which may be inflicted on the vesical wall Moreover some stones especially those consisting of oxalate of lime are so hard that no lithotrite can crush them Phosphatic concretions on the other hand are so soft that a lithotrite becomes clogged and crushing is impracticable An encysted stone will also preclude lithotomy on account of its fixed position There is no objection to dealing with multiple calculi by this means if of small size they may be removed by simply using the evacuator (2) *Conditions of the Urethra* The existence of an organic stricture or an enlarged prostate may render lithotomy impracticable from the impossibility of passing large enough instruments whilst false passages may make it exceedingly difficult Excessive irritability of the urethra as evidenced by the occurrence of severe rigors after instrumentation may also render the operation unadvisable (3) *Conditions of the Bladder* The existence of severe cystitis or the presence of sacculi as indicated by the cystoscope will usually suggest the performance of lithotomy a contracted bladder which will only hold a few ounces materially increases the dangers and difficulties of lithotomy

Suprapubic Lithotomy should be undertaken under the following conditions (1) Where the stone is too large to be dealt with by crushing (2) where the stone is encysted (3) where a stricture or enlarged prostate is present and it may then be feasible to remove the prostate at the same time

Calculus in Boys is a common occurrence It must be remembered that the bladder is rather an abdominal than a pelvic organ in children and hence suprapubic lithotomy is particularly indicated except in the hands of skilled lithotritists It has been shown however that lithotomy can be safely practised and many surgeons in the East where stone is common employ it as a routine procedure granting that a No 6 catheter can be passed and that the stone is not too large to be grasped by a lithotrite Specially constructed instruments are required for the purpose

Calculus in the Female—As already mentioned vesical calculus is very rare amongst women owing to the shortness and greater size of the urethra so that small stones passing downwards from the kidneys are easily voided Phosphatic concretions are not uncommon and are due to the presence of a foreign body usually introduced by the patient **Treatment**—Litholapaxy is usually indicated but for really large stones suprapubic cystotomy is the best procedure It is never desirable to open the bladder through the anterior vaginal wall so as to remove a stone for fear of the persistence of a vesico-vaginal fistula

Functional Derangements of the Bladder.

The act of micturition is a complicated proceeding which for its effective performance requires the due co ordination of several factors. When urine collects in the bladder, it is prevented from escaping at once by the tonic contraction of the sphincter vesicæ in infants this is but little developed and hence is readily overcome by the relatively strong detrusor in response to but slight intravesical pressure. As the child grows the sphincter becomes better developed, and is under more effective control whilst at puberty the growth of the prostate adds to this and therefore micturition loses its reflex character and becomes entirely voluntary. Three chief elements enter into the act of urination viz (1) an appreciation of the stimuli set up in the bladder by its increasing distension which depends on the sensory nerves having a free communication with the sensorium (2) as a result of this stimulus the sphincter vesicæ is voluntarily inhibited and (3) the detrusor muscle is contracted, expulsion of the urine necessarily following. A voluntary contraction of the abdominal muscles is often employed to assist in this expulsive effort. Each of these muscular elements has its own central control the sphincter in the inferior mesenteric and hypogastric plexuses, the detrusor in the lumbar enlargement of the spinal cord and it is possible for one or both of them to be destroyed or weakened. Should the sphincteric control become weak, the activity of the detrusor may be relatively increased and the bladder contents are expelled too frequently (active incontinence). Should the sphincteric control be relatively increased, the expulsive efforts of the detrusor will be hindered and retention results. Necessarily, other causes than nervous enter into the production of these two conditions, and hence they must be considered separately.

Incontinence of Urine—A patient is said to be suffering from incontinence when the urine escapes involuntarily, dribbling away either constantly or intermittently from the urethra.

1 **Active Incontinence (Enuresis)** is often present in young children, mostly boys, in whom as already indicated, sphincteric control is not too well developed. It results from some condition of increased excitability of the urinary apparatus, and is looked on by some as of a choreic nature. The chief local sources of irritation are phimosis, ascariæ in the rectum, a rectal polypus, or urine of high specific gravity, containing uric acid crystals in suspension. The affection is most obvious at night, and may only occur during sleep, it usually disappears when adult life is reached, if not cured before, but has been known to persist. Treatment of the nocturnal incontinence consists in the removal of all sources of irritation, such as a tight foreskin. Tonics, e.g. iron, arsenic, and quinine, may be administered, and tincture of belladonna should also be given in full doses. The boy must not be allowed to lie on his back or to eat or drink late at night, but must be kept warm and should be waked at regular intervals to pass water. All excitement of the sexual senses must also be avoided. During the day also the patient should be watched, and not allowed to run to the lavatory continually, the bladder must be trained to hold its contents. Parents

and school teachers should be instructed and their co-operation secured so as to train the child in habits of restraint. If this can be gained during the day the nocturnal habit will cease.

2 **Passive Incontinence** is said to be present when the neck of the bladder is relaxed so that as soon as any urine is secreted it flows out of the urethra—the bladder in this way never becoming distended. The cause of this condition is mainly mechanical such as the holding open of the internal meatus by a pedunculated growth from the prostate or an impacted calculus. It sometimes occurs in women from over distension of the urethra as for removal of a calculus.

3 **False Incontinence, or Distension with Overflow**, may be the outcome of an attack of retention naturally relieved or is due to any condition in which the outflow of urine is impeded to such an extent as to lead to a certain quantity being left in the bladder after every act of micturition although the patient imagines that the organ has been completely emptied. This so-called *residual urine* gradually increases in amount until the bladder becomes filled and then some of it dribbles away involuntarily so as to wet the patient's clothes. In old-standing cases the bladder can be detected as a tense rounded swelling in the hypogastrium. This condition is usually met with in patients with neglected stricture or enlargement of the prostate and in the latter case the bladder may be so distended as to contain many pints of urine. Very much the same state of things obtains in paralysis due to spinal mischief. Treatment must be directed to keeping the bladder emptied by the regular use of a catheter but it often remains in an atonic state for some time.

Retention of Urine—When a person is unable to expel the contents of his bladder so that it becomes distended retention is said to be present. It results from a variety of conditions which may be classified as follows.

1 **Mechanical obstruction** which may involve any part of the urethra or the neck of the bladder the actual cause varying somewhat with the age and condition of the patient. Thus in infants the most common cause of retention is the narrowed orifice of a tight phimosi; in children an impacted calculus in the urethra or a ligature tied round the penis in young men gonorrhœa or one of its complications in young women foreign bodies in the urethra or bladder in adult men stricture in adult women uterine fibroids or some uterine condition compressing the bladder or urethra and in old men hypertrophy of the prostate.

2 **Nervous lesions** may be responsible for some cases. Anything that excites the sphincteric energy or diminishes the activity of the detrusor muscle may determine retention and thus it may be brought about in many ways. (a) Spasm of the sphincter may result from mental perturbation or excitement a person being unable to micturate in the presence of others. (b) **Neurosis** is a common cause as in hysteria or shock and a reflex neurosis is responsible for retention after injuries or operations especially when the latter are somewhere in the neighbourhood of the genital organs as for piles hernia varicocele etc. (c) **Organic disease of the nervous system** produces retention as in tabes

disseminated sclerosis, traumatic and neoplastic conditions of the cord etc

3 Inflammatory diseases of the bladder may be followed by difficulty in micturition as the result of fibrosis of the vesical wall, which is perhaps most frequently seen after gonorrhœal cystitis

4 Retention is sometimes the outcome of habit or circumstances, as in clerks or school teachers, and then when the opportunity to micturate occurs the act cannot be completed

If left unrelieved, the urine accumulates and the bladder becomes distended. One of two conditions is certain to follow (a) In cases of retention from stricture, or when a calculus is impacted in the urethra the dilated urethra behind the seat of obstruction gives way, resulting in perineal extravasation of urine. If, however, the bladder wall has been weakened as the result of ulceration, or if it be sacculated, rupture of that viscus may occur, and pelvic extravasation may follow (b) When the retention is not due to complete obstruction of the passages, the distension is in time followed by unconscious overflow, and relief is thereby obtained, although the bladder wall often becomes atonic

The treatment of retention necessarily varies with the cause, as it is but a symptom

Atony of the Bladder is the term applied to a condition in which the patient is unable to expel the contents, not on account of any true paralysis, but simply from loss of tone of the muscular wall. The causes are the same as for retention, and the condition may be determined by a single act of over distension, or be the outcome of a more chronic obstruction. Thus, owing to the oversight of a house-surgeon, it occurred in a patient who had been operated on for varicocele and was left unrelieved for twenty-four hours. More commonly, however, it is met with in old people who are suffering from retention due to enlargement of the prostate, or in men who are the subjects of stricture of the urethra

In the slighter cases all that is noticed is some hesitation or difficulty in commencing the act of micturition, whilst the flow itself is weak, the urine escaping with no force, and often dribbling away after the act is apparently completed. In bad cases a considerable amount of residual urine may be left in the bladder, the decomposition of which may lead to chronic cystitis. The Treatment should be directed to removing any source of obstruction which exists, regular catheterism two or three times a day will prevent any distension of the bladder, and the administration of strychnine, phosphoric acid, and other tonics will improve the expulsive power of the viscus. The passage of a constant current of electricity may also be employed two or three times a week to stimulate the muscular fibres, one electrode is inserted into the bladder, and the other placed over the hypogastrium

Affections of the Prostate.

Acute Prostatitis arises most usually as a sequela of gonorrhœa, either in its acute or chronic stage, by direct extension backwards of the inflammatory process, it is also occasionally met with as a result

of stricture arising from the irritation of retained and decomposing urine or from the passage of instruments. It is said to be induced by the application of cold or damp to the perineum as by sitting on cold stones or damp grass but probably this has been preceded by bacterial invasion of the posterior part of the urethra. Suppuration follows in not a few cases being due to the infection of the prostatic follicles with pyogenic organisms. Sometimes merely one or two superficial follicles are affected causing what is termed a *follicular abscess* occasionally the mischief extends much more widely involving the whole of one lobe or perhaps the whole organ and constituting a *parenchymatous abscess*.

The Symptoms consist of deep-seated pain referred to the neck of the bladder with perhaps a sense of weight and fulness about the perineum and pain referred to the end of the penis. Micturition becomes frequent and painful and defecation may cause considerable distress. As the organ increases in size the pain becomes more and more severe and all movements of the body as also the act of sitting are increasingly difficult. On rectal examination the organ can be felt enlarged hot and tender. Suppuration is likely to follow and retention of urine may be thereby induced. A follicular abscess bursts into the urethra spontaneously or is ruptured by the passage of a catheter for the relief of retention the opening however is sometimes of a valvular nature and only a small portion of the pus escapes. The process may then continue to spread and the pus may find its way into the rectum or come to the surface through the perineum. In either of the latter conditions a rectal or perineal fistula is liable to result. Considerable constitutional disturbance and fever are usually associated with this affection whether suppuration occurs or not. The formation of a parenchymatous abscess is always attended with much more acute symptoms both general and local. The organ is larger and produces more rectal irritation a considerable quantity of pus may form, and suppuration may extend beyond the capsule.

Treatment.—The patient should be kept in bed on a restricted diet and the bowels freely opened by saline purges combined with small doses of antimony and perhaps full doses of hyoscyamus. Hot hip-baths are also very valuable and linseed meal poultices may be placed on the perineum. Extreme pain should be relieved by the use of morphia suppositories and if the urine needs to be drawn off a soft rubber catheter of small size should be used. If an abscess forms and is not opened by the passage of a catheter or if the natural opening is of a valvular character so that the cavity cannot completely empty itself an incision must be made into it through the middle line of the perineum being guided by a finger placed in the rectum pus may not be reached until the knife has entered to a depth of about 2 inches. Urine will sometimes escape from this opening and may continue to do so for some considerable time. If gonorrhoea is also present suitable treatment must be adopted in order to check the discharge. When the abscess is pointing in the rectum it may be wise to open it from that cavity but every effort must be made to avoid this contingency as a recto-urethral fistula may result.

Chronic Prostatitis is perhaps one of the most common causes of chronic gleet after gonorrhœa and arises as a sequela of an acute attack. it may also be a result of stricture.

The Symptoms produced by it are a sense of weight and fulness about the perineum combined with irritability of the bladder and pain referred to the extremity of the penis at the end of micturition owing to the bladder contracting upon the hyperæmic and sensitive organ. A glairy discharge of viscid material similar in appearance to uncooked white of egg (*prostatorrhœa*) is often present and fine threads of mucus are usually seen floating in the urine being due to the formation of mucous casts of the prostatic ducts. On examination through the rectum the organ can be felt enlarged and tender and the vesiculæ are usually in the same condition. Chronic suppuration may follow the abscess bursting into the urethra or rectum or pointing in the perineum.

The Diagnosis from tuberculous disease can usually be made by careful attention to the history and physical signs.

Treatment consists in massage of the prostate from the rectum so as to empty the vesiculæ and prostatic follicles and in effective irrigation with permanganate of potash solution as for gonorrhœa (p. 147). Diathermy (p. 148) is useful and the local application of organic salts of silver *eg* argyrol protargol etc. is valuable a small quantity is introduced into the prostatic urethra by a special porte-caustique. The passage of large solid bougies with a view to dilate the urethra and compress the prostatic follicles is also of use. The general routine treatment of gleet must be enforced (p. 147).

Tuberculous Disease of the Prostate is usually met with as a result of extension from similar disease in the epididymis the seminal vesicles being also invaded possibly it may arise as a primary affection. In either case it rapidly spreads to the bladder and thence to the ureters and kidneys. The prostate is usually found to contain caseous masses which break down leading to extensive ulceration and sometimes the organ is riddled with ragged cavities. The symptoms are those of irritability of the neck of the bladder combined with pain referred to the end of the penis or mainly noticed in the back or perineum. Hematuria may occur but pyuria is almost constant. The urine is feebly acid or neutral and on examination of the pus tubercle bacilli may be detected. Rectal examination will demonstrate an irregular enlargement of the organ and if the vesiculæ are invaded they can also be felt.

Treatment consists in the usual anti-tuberculous measures and the injection of tuberculin may prove of some value. If the disease is not too extensive benefit may be derived from removing the tuberculous tissue through a perineal incision.

Prostatic Calculi are infrequent being usually met with in cases of chronic prostatitis especially that resulting from stricture of the urethra or previous attacks of gonorrhœa. They are generally multiple and of small size consisting mainly of carbonate of lime. They develop primarily in the glandular crypts and may remain embedded in a pouch or pocket of the organ giving rise to but little inconvenience. When

large and protruding from the gland into the urethra, great irritability of the neck of the bladder is induced, together with symptoms of obstruction to the flow of urine, on passing a catheter or sound a distinct click or grating may be noticed. Diagnosis can be effected in some instances by radiography, the calculi casting shadows usually a little below the brim of the pelvis. These stones cause a prostatitis often productive of a considerable urethral discharge, and when great difficulty of micturition or even acute retention occurs, this may lead to an erroneous diagnosis of a gonorrhoeal stricture, unless careful attention is paid to the history and to the rectal examination, when the hardness is felt in the gland. It is sometimes possible to remove the calculi through the urethra, but more frequently a perineal incision is required.

Enlargement of the Prostate (or, as it used to be termed, *senile hypertrophy*) is a condition rarely seen under fifty years of age, characterized by a chronic persistent overgrowth of the organ, which results in interference with the act of micturition, and may finally destroy life by inducing secondary changes in the bladder and kidneys by prolonged backward pressure. As to causation but little is known. Recent experimental work in animals shows that a similar condition can be produced by the administration of *œstrin*, and it is possible that in man prostatic enlargement is the result of excessive *œstrin* production by the testis, or a deficiency of an anti-*œstrin* substance. It may attain a considerable size, perhaps constituting a tumour as large as one's fist and weighing 200 grammes, the average normal weight of the prostate being about 18 grammes. It may be of hard or soft consistence, and in the latter case is extremely vascular. The vascularity varies from time to time, and the patient is liable to sudden attacks of congestion, which aggravate the symptoms. On section the organ may appear to be homogeneous and of the same texture throughout, but most commonly it consists of a number of firm rounded masses, sharply defined, and held together by a certain amount of connective tissue. Outside these is an ill-defined layer of stretched (and sometimes atrophied) muscular tissue, containing a few glandular elements, but continuous with the stroma, and constituting the true capsule of the organ. Still further out is the extrinsic sheath derived from the pelvic fascia (mainly recto-vesical), it consists of two layers, between which are the veins of the prostatic plexus.

Histologically, an enlarged prostate consists of an overgrowth of the glandular tissue, sometimes diffuse, more frequently in the form of multiple adenomata, set in a connective-tissue basis developed from the prostatic stroma of muscle fibres. Cystic changes are not usually observed in these adenomata. Occasionally a few fibro-myomata may develop, but they are decidedly uncommon. Malignant disease is liable to supervene in rather more than 10 per cent. of the cases, either in the periphery as a localized, firm, inelastic nodule closely attached to the capsule, or in the centre of a lobule.

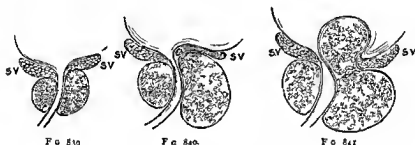
The changes induced in connection with an enlarged prostate are numerous and important.

1. The prostatic sheath of pelvic fascia becomes thickened and

condensed thereby preventing any downward expansion of the organ and directing its enlargement upwards

2 The close connection between the capsule and the sheath which is so marked a feature in the normal anatomy of the organ is profoundly modified so that it becomes easy to enucleate the gland in its entirety from its surroundings

3 The relations to the bladder wall are also much altered. Normally the sphincter (Fig 839 SV) is interposed between the prostate and the vesical mucosa. As the gland enlarges this relation may persist (Fig 840) and although the bladder base is raised up the growth is extravascular and the sphincter muscle is stretched over the enlargement. More frequently however the gland as it enlarges insinuates itself between the sphincter and internal meatus constituting an intravesical projection (Fig 841). This is generally most marked in the middle line behind constituting the so called middle lobe (Fig 842) but it



FIGS 839 841 — DIAGRAMS TO ILLUSTRATE RELATION OF THE PROSTATE TO THE SPHINCTER VESICÆ (SV)

In Fig 839 the prostate is supposed to be of normal size and the sphincter lies above it. In Fig 840 the prostate is enlarged but has no intravesical projection of middle lobe and hence the sphincter retains its normal relation. In Fig 841 the most common type of prostatic enlargement, a well marked intravesical projection or middle lobe exists, the sphincter being displaced backwards by this development.

may involve the whole gland which projects into the bladder as a collar like enlargement around the meatus whilst sometimes one or both of the lateral lobes are chiefly affected in this manner. The gland also pushes backwards between the seminal vesicles which in time are displaced from their connection with the back of the bladder and constitute a posterior relation with the enlarged organ. It is interesting to note that this overgrowth involves mainly if not entirely the upper part of the gland and that the portion below the verumontanum is rarely affected so that the openings of the ejaculatory ducts are not displaced backwards.

4 The changes produced in the prostatic urethra and neck of the bladder vary considerably in different cases. The length of the urethra is always increased perhaps by 2 or 3 inches or even more. Some amount of obstruction to the outflow of urine is universal. In rare instances it may be due to an adenoma becoming pedunculated and projecting downwards into the urethra as a polypus. Occasion

ally the base of the middle lobe becomes narrowed, probably as the result of constriction by a band of longitudinal muscle fibres passing down on either side from the urethral orifice to the meatus, the middle lobe thereby becomes more or less pedunculated, and may be movable, constituting a ball valve which determines retention, or else wedging open the internal meatus and causing incontinence. As a rule the outflow of urine is hindered by the 'prostatic bar,' caused by the projection of the middle lobe, which also hinders the entrance of a catheter. When both lateral lobes are enlarged symmetrically, the lumen of the urethra is diminished from side to side, being narrow or chink like instead of triangular, but its vertical measurements are increased. Asymmetrical enlargements, of course, displace the urethra to one or other side.



FIG 842—ENLARGED PROSTATE WITH A LARGE INTRAVESICAL PORTION (FROM COLLEGE OF SURGEONS MUSEUM)

5 The effect of an enlarged prostate on the bladder is important. The obstruction to the outflow of urine leads to increased expulsive efforts on its part, and consequently the wall becomes thickened and hypertrophied. This involves the muscular fibres, which stand out prominently as rounded fasciculi, and the mucous membrane may project outwards between them as hernial protrusions, constituting saccules in which urine may stagnate and decompose, and even phosphatic concretions form.

In almost every case the enlarged prostate projects more or less into the vesical cavity, either as a collar like mass around the internal meatus, or as one or more rounded outgrowths. This is necessarily associated with a pouching backwards of the lowest part of the bladder (*prostatic pouch*), which, being below the level of the meatus, does not become emptied during the natural process of micturition, and in it *residual urine* is therefore able to collect and remain.

Cystitis will in time follow, caused either by infection from within or by the use of unsterilized instruments, the bladder wall becomes inflamed, ammoniacal decomposition of the urine follows, and phosphatic concretions not infrequently form, finally, renal complications ensue (due either to back pressure or to an ascending pyococcal infection), and these may determine a fatal issue.

The Symptoms vary somewhat with the nature and position of the

enlargement The patient at first finds some difficulty in micturition, especially at the commencement of the act, straining often hinders rather than assists The stream is not necessarily smaller than formerly, but is projected with less force Gradually irritability of the bladder ensues, and the patient has to pass water very frequently, a trouble especially noticed during the night Some degree of pain and a sense of weight and fulness about the perineum are also experienced and tenesmus, or even hernia, may be induced by the straining Intermittent attacks of increased pain and difficulty in micturition occur from time to time generally resulting from exposure to cold and wet, and presumably due to congestion of the prostate After lasting for a few days the more acute symptoms slowly disappear, if judiciously treated

As the obstruction increases, a certain amount of residual urine remains within the bladder after each act of micturition, the vesical muscles in time losing power and becoming atonic Well marked distension and atony of the bladder ensue at length in neglected cases, the urine dribbling away and wetting the clothes Decomposition of the retained fluid follows, accompanied by cystitis with increasing vesical irritation and muscular spasm, the urine becomes ammoniacal and contains muco-pus and phosphates, this process, if untreated, is certain to lead to hydronephrosis and pyelonephritis The general health of the patient is slowly undermined by the constant irritation and want of sleep induced by these changes, as also by toxic absorption, and the final chapter may be ushered in by symptoms of uræmia from the mischief inflicted on the kidneys

Occasionally the early symptoms may pass unnoticed for a considerable time, the patient imagining that the frequent calls to pass water are good signs rather than evidences of disease In these cases the bladder may become overdistended, and the condition unsuspected, until, owing possibly to some exposure to cold or over-indulgence in alcohol, complete retention is induced, and then, to the surprise of the patient, an enormous amount of urine is withdrawn on the passage of a catheter Priapism is sometimes a troublesome con-

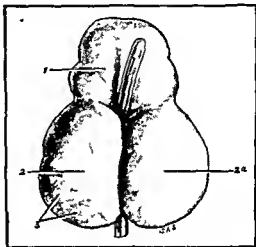


FIG 843.—ENLARGED PROSTATE AFTER REMOVAL BY SUPRAPUBIC OPERATION

The catheter has been placed in the urethra 1 The so-called middle lobe or intravesical projection behind the internal meatus 2 and 2' the lateral lobes 3 indicates some of the nodular adenomatous masses which constitute the bulk of the swelling

dition and the effect of this on the moral sense may be very serious, even leading to acts of gross indecency.

The Diagnosis of enlarged prostate is made partly by a consideration of the symptoms complained of but mainly by an examination of the organ from the rectum. The age of the patient the increasing irritability of the bladder by night *and* day the fact that straining hinders rather than helps the expulsive act together with evidence of vesical distension—all these facts indicate that the seat of obstruction lies in the prostate. A rectal examination is then instituted and bimanually a fair idea can be gained of the size and condition of the organ. The normal prostate is about the dimensions of a horse-chestnut the enlarged organ constitutes a smooth rounded mass varying in size usually soft and somewhat movable. The degree of obstruction to the urinary outflow cannot be gauged from the rectum but is rather determined by the amount of residual urine. This is effected by asking the patient to empty his bladder and then passing a soft catheter merely 2 or 3 ounces of urine may be withdrawn but in bad cases anything up to 2 or 3 pints may escape. The actual degree and situation of the intra-urethral projection of the gland is seen at cystoscopy.

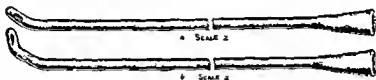


FIG 544 CATHETER COUDE (a) AND BICOUDE (b)

It must not be forgotten that an enlarged prostate may be associated with a stricture the existence of which becomes evident on passing a bougie or catheter. The presence of a stone or stones in the bladder is indicated by severe cutting pain during micturition as also by radiography. The secondary onset of cancer can only be guessed at in the early stages if the gland appears flat hard and fixed at one spot if it commences in the centre of a lobule it is unrecognizable. For the diagnosis from primary cancer of the prostate see p. 1435.

Catheter Life—To pass a catheter in a case of enlarged prostate is not always easy owing to the fact that the middle lobe (Fig. 541) projects across the urethra and bars the onward progress of an instrument of the ordinary shape. A rubber catheter should always be employed if possible and failing that a catheter coude or bicoude (Fig. 544) which consists of a soft straight instrument of the usual French type the end of which is bent or doubly bent at an angle like an elbow so as to enable it to ride over the obstruction. Only in difficult cases associated with acute retention should the surgeon resort to the silver prostatic catheter which is longer and more curved than usual and the handle of which requires to be well depressed between the thighs after the point has cleared the pubic arch. Whichever method is adopted no force is required since with a little skill the point of the instrument will pass round the obstruction and enter the

bladder Every precaution must be taken to ensure the sterilization of all instruments, and it should be remembered that as a rule large rather than small instruments will pass more easily

During the first fortnight of catheter life the patient must be carefully guarded from cold and exposure Not infrequently a certain amount of fever is produced, which either passes off in a few days, or may increase, together with symptoms of chronic cystitis, running on to a fatal issue at the end of three or four weeks This condition probably arises from septic causes, but possibly reflex nervous disturbance plays some part in its production The only treatment required in the simpler cases is to keep the patient warm in bed, to limit his diet, to administer quinine and perhaps opium, and to keep the bowels well open

During the continuance of catheter life, the patient must be warned to live quietly, and abstain from all excesses, especially as regards eating and drinking, sexual excitement should be avoided, and horse-exercise forbidden, precautions must also be taken to ensure protection from cold and damp The administration of alkalis is desirable if the urine is highly acid, so as to diminish the irritability of the bladder

Under such a regime, it is possible that the patient may live in comparative comfort perhaps for years, the progress of the affection being entirely checked in some instances In others, the patient suffers from *intermittent attacks of congestion* of the prostate, with increased pain and irritability of the bladder, and augmented difficulty in micturition These are usually brought about by exposure to wet or cold, or by injudicious indulgence in alcohol Treatment consists in keeping the patient warm in bed, and, if convenient, placing him in a hot hip-bath night and morning The diet is restricted to fluids, milk and barley-water being the best tea and coffee are forbidden The bowels are freely opened, and the use of hot enemata is desirable, thereby fomenting the prostate a belladonna suppository after the enema is comforting A mixture containing acid phosphate of soda and tincture of hyoscyamus is administered six hourly, and urotropin in the intervals If possible, catheters are avoided, but must be passed if necessary, and in cases of great difficulty a catheter may be tied in Suprapubic cystotomy may be required for retention which cannot be relieved by catheter, or for severe cystitis and general asthenia

In the majority of cases, however, when the patient has well defined symptoms of prostatic overgrowth, including some ounces of residual urine, he will probably prefer to undergo operative treatment, which will restore to him a condition of normal micturition, rather than submit to the daily inconveniences associated with catheter life Some little discrimination is required in case selection and pre-operative investigation The total daily urinary output must be measured, and its urea content measured after a urea meal with an indwelling catheter if necessary The general condition of the patient, especially as to vascular degeneration and cardiac power, must also be carefully considered

In suitable cases the operation is best undertaken in one stage, but in the presence of impaired renal function, infection, or general

ill health it is wise to perform the operation in two stages undertaking suprapubic cystotomy first and proceeding to prostatectomy with return of adequate renal function etc

Treatment—**Suprapubic Prostatectomy** is now established as the ideal treatment for the enlarged prostate. The modern operation is some modification of the *Harris technique* and the mortality in his hands has fallen to about 2 per cent.

Before proceeding to operative measures the patient must be fully investigated to determine his fitness and the nature of the gland to be removed. Rectal examination will give some idea as to the size and consistency—this must be confirmed by cystoscopy when the intravesical projection of the gland will be observed, the residual urine measured and a catheter specimen sent for bacteriological investigation. The renal function will be decided by means of a urea concentration test and blood urea. Some surgeons prefer indigo carmine. Provided then the patient has a large mobile prostate, satisfactory renal function tests, no cardiac or pulmonary or other contrary indications, suprapubic prostatectomy can be advised.

Operation—The anæsthetic varies with the individual patient but spinal anæsthesia (percaïne, stovaine) or open ether with novocain $\frac{1}{2}$ per cent into the rectus abdominialis muscle are both popular.

A gum elastic catheter is passed and the bladder distended with 8 oz of boracic lotion. A suprapubic mid line incision giving adequate exposure from the symphysis pubis up nearly to the umbilicus is used (the same operation is often done through a transverse incision with some division of the rectus muscle). The peritoneum is stripped off the bladder which is opened and the contained fluid aspirated. The prostate gland is enucleated commencing anteriorly and to the left side of the gland, sweeping round posteriorly. This preserves a larger flap of mucous membrane on the floor than by tearing through the mucous membrane behind the middle lobe.

At the end of enucleation the mucous membrane of the prostatic urethra is divided by the finger over the gum elastic catheter, the patient is placed in Trendelenburg's position and illuminated bladder retractors introduced with a lighted retractor in the prostatic cavity (Fig 844A). Any spurting vessel will be seen, secured by forceps and stitched, two ligatures are often needed, one each side of the prostatic rim at about four and eight o'clock. A boomerang needle is now introduced deeply behind the inter ureteric bar, pushed downwards and brought to the surface just short of the torn prostatic urethra, this is threaded with catgut No 2 and withdrawn. After tying this stitch it will be noted that the trigone area of the bladder has been drawn down so as largely to cover the prostatic bed. It is essential that this stitch be introduced in the mid line so as not to injure either ureter. A stitch is now introduced laterally horizontally across the prostatic cavity using the boomerang needle (Fig 844B). This is tied and a similar stitch introduced below this well obliterating the prostatic cavity.

As a rubber catheter is needed for drainage it is customary to withdraw the gum elastic catheter and introduce a No 12 Mallecot on a

stilette after the introduction of a trigonal suture and before placing the transverse stitches. The end of this catheter is cut off and a lateral eye is made and a silkworm gut stitch passed through and brought out through the suprapubic wound. Hæmorrhage is now

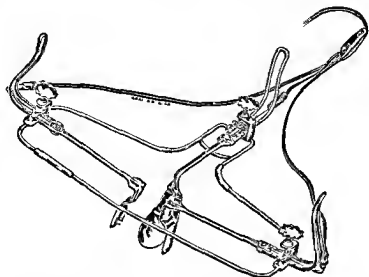


FIG 844A—HARRIS'S ILLUMINATED BLADDER RETRACTOR

usually adequately controlled. Occasionally a third transverse stitch may be needed.

The bladder can now be closed without drainage but if there is any doubt as to the efficiency of the hæmostasis it is advisable to leave a small tube the size of a No 8 or No 10 catheter so that more adequate washouts can be given. The bladder is sewn up in the usual way.



FIG 844B—HARRIS'S BOOMERANG NEEDLE

and the layers of the abdominal wall. A small tube is required to drain the prevesical space whether the bladder is completely closed or not. These tubes are fixed in the lower end of the incision and the silkworm gut is brought out separately and tied over a rubber or glass tube so as firmly to hold the catheter in position.

Freyer's Operation.—This consisted of a blind enucleation of the

prostate gland after which the bladder was not opened widely and any gross bleeding was controlled by packing.

Tolson Walker Operation was a great advance, as here, after enucleation of the gland automatic retractors were introduced tags removed and bleeding points secured the shelf of the mucous membrane below the trigone was divided to prevent post-operative obstruction and a hæmostatic stitch was introduced at the rim.

Harris Operation is described above the advantages being greater hæmostasis and a shorter period if any of bladder drainage with consequent diminution in the risk of infection.

If preliminary suprapubic drainage has been established the operation is as indicated except that the original track will need to be excised and the bladder mobilized from the symphysis pubis and other attachments to enable satisfactory suture at the conclusion.

After-Treatment—The bladder must be irrigated at frequent intervals (half hourly to start with) with small quantities of warm silver nitrate solution (1:10,000) whether the suprapubic drain is in position or not to prevent these tubes of small lumen becoming blocked by clot. The bladder tube is usually removed in twenty-four hours, the perivesical in four days the wound heals rapidly and there seems to be no tendency to post-prostatectomy obstruction. The necessity for frequent irrigation in the first twenty-four hours has been emphasized. Morphine is useful to relieve the pain and spasm and may be given as a suppository or hypodermically. While there is suprapubic drainage of urine Irvin's apparatus may be employed consisting of a metal cup fitting closely over the wound kept in place by elastic bands round the body draining into tubes which carry away the urine into a bottle between the legs. This keeps the patient dry and saves the expense of a dressing. The bladder is irrigated daily through the urethral catheter which is usually left in position for about fourteen days. After it has been removed the patient usually is passing his urine naturally but occasionally it is necessary if a suprapubic leak occurs for a rubber catheter to be introduced for a few days to allow the completion of healing.

Transurethral Operations—In this country trans-urethral resection is most commonly carried out by the McCarthy resectotome (Fig. 844c) although in America some form of the punch cautery is frequently used. Resection consists of the removal of pieces of prostatic tissue through a large endoscope by means of a wire loop electrode using a cutting current under vision. This is rendered possible by the McCarthy visual system and improved irrigation. Sterile water must be used for this purpose with no electrolytes to disseminate the current. This should only be carried out by a surgeon extensively skilled in cystoscopic manipulations as in inexperienced hands it may lead to perforation of the bladder into the peritoneal cavity or into the rectum.

By this means it is possible to gouge a channel through the prostate gland and allow satisfactory micturition to be re-established. It is of chief use in fibrous prostates where a small amount of tissue needs to be removed—there is little tendency to bleeding or for any large

lateral lobe to fall together again. Secondly, as a palliative measure in carcinoma, which is justifiably preferable to a permanent suprapubic cystotomy. It also has considerable indication in simple enlargement of the prostate gland, when these patients, for any reason, could not be subjected to the major operation of prostatectomy. The chief disadvantages of this procedure for simple enlargement are the

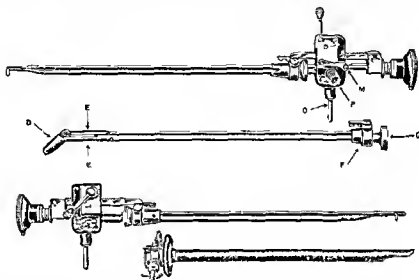


FIG. 844C—McCarthy Resectotome showing its component parts

occurrence of sepsis and the tendency to leave the patient with some chronic infection in the remaining prostate gland, for the remaining lateral lobe to continue growing, and for further operation to be necessary in three or four years' time.

Any bleeding at the time of operation is controlled by changing to a bulbous electrode and coagulating under vision with the diathermy current (Fig. 844D).



FIG. 844D—Diathermy electrode and cutting loop electrode

If preliminary drainage has been established the operation is in no way altered and the urethral catheter will need to be reintroduced after about a week to allow closure of the suprapubic wound.

The after-treatment is much the same as for the Harris prostatectomy, the catheter being introduced at the conclusion of the operation and frequent irrigations being advisable. The catheter is usually

removed on about the fifth day, the patient being allowed up in one week provided no complications have occurred

Suprapubic Cystotomy is frequently indicated, mainly as a preliminary to either prostatectomy or trans urethral resection. Both these operations require satisfactory renal function tests before they can be embarked on with safety. The patient therefore with poor tests should have a temporary drainage established and have his urea concentration test and blood urea done at regular intervals until these are deemed worthy of further operative interference.

A permanent suprapubic cystotomy is now very rarely indicated for prostatic obstruction, except in certain cases of carcinoma where it is not possible to introduce the resectotome owing to the tortuous and lengthy rigid urethra and in certain cases of benign enlargement where the renal function does not improve sufficiently for a resection to be carried out or where the enlargement is so great that possibly four or five resections would be indicated to give an adequate channel.

In these cases a De Petzer or Mallecot catheter is introduced through a small suprapubic incision, this may be connected to a portable urinal worn in the trousers. Most patients, however, are happier when the tube is plugged with an ordinary wooden spigot which can be released at regular intervals to allow the escape of urine. Regular bladder washouts will be needed to keep the bladder clean.

Steinach Operations—Steinach 1 the vaso ligation originally introduced as a rejuvenating procedure is now largely carried out in prostatic surgery, but merely with the idea of preventing the spread of infection to the epididymis. It may be done at the time of the temporary suprapubic drainage or in one stage operations at the conclusion of a prostatectomy or trans urethral resection. It certainly prevents epididymitis a distressing complication and has a distinct place in prostatic surgery.

Steinach 2 ligation of the vasa efferentia between the testis and the epididymis again originally introduced as a rejuvenating operation, has been said to give beneficial effects in enlarged prostates the reasons offered for this are (a) that by destruction of the spermatogenic function an increase of male hormone is promoted which will cause the prostate gland to shrink or (b) by interference with the sympathetic ganglion at the head of the epididymis an immediate reflex effect is produced.

Statistics at the present moment are unreliable, but there seems to be definite evidence that for early prostatic cases the development of the full syndrome may be averted, or at any rate postponed although it is not possible at present to say for how long.

It may also be used to some advantage on very feeble patients who would not stand the proverbial 'haircut and shave' in two stages, as operation involves virtually no shock and can be done under local infiltration anaesthesia.

Cancer of the Prostate occurs in elderly men, but is more common than was formerly supposed, it is usually of a scirrhus type, though sometimes it is of a soft nature, in either form it early progresses beyond the limits of the capsule. The symptoms produced are at first similar

to those caused by simple enlargement of the prostate, but the progress of the case, though slow at first, is after a time much more rapid, the amount of pain and discomfort is much greater, and the pain is often referred to the back of the thighs and down the legs. Later on hæmaturia may occur. On rectal examination a hard mass is readily detected, fixed more or less to surrounding parts, and perhaps with outlying nodules distinct from the main mass, secondary deposits may be found in the lumbar and abdominal glands on palpating the abdomen. Occasionally phenomena referable to pressure on the abdominal vessels and nerves arise, and the symptoms of general cachexia early manifest themselves. Palliative treatment alone can be adopted in the majority of cases. operative measures to remove the whole organ, including the base of the bladder, have been practised, though with doubtful advantage. Radium, too, has not proved very successful, and, indeed, seems at times to favour local dissemination of the growth.

Trans urethral resection has been mentioned, and undoubtedly affords a happier end to these unfortunate patients, although in some cases permanent suprapubic drainage will be necessary.

CHAPTER VII

AFFECTIONS OF THE URETHRA AND PENIS

Affections of the Urethra.

Congenital Malformations.—Total Absence or Occlusion, of the urethra has been met with the urine under such circumstances being sometimes retained and leading to dilatation of the bladder ureters and kidneys a condition rapidly fatal even if the child be born alive. In a few cases the urachus remains patent and a congenital urinary fistula is established at the umbilicus in others the cloacal condition permits the rectum communicating with the bladder.

Epispadias is a deformity in which the urethra is partly or wholly exposed along the upper surface of the penis. In rare instances the external meatus is situated just above the glans which is cleft and deeply grooved superiorly. More commonly the urethra opens at the root of the penis just in front of the symphysis and in such patients the organ is always rudimentary and stunted. Complete epispadias is only present when associated with extroversion of the bladder (p. 1283). The incomplete form has been treated with success by the use of reversed flaps dissected up from the side of the penis. For details of the operations on this and the following conditions see textbooks on operative surgery.

Hypospadias or defective development of the lower wall of the urethra is a much more common malformation than the foregoing. Three varieties are described. In (a) *hypospadia glandis* the opening of the urethra corresponds to the position usually occupied by the frænum and is thus directed downwards instead of forwards. The prepuce in these cases is always voluminous and hangs like a hood over the glans which is bent down over the orifice. (b) *Hypospadia penis* is characterized by the urethra opening somewhere along the under surface of the body of the penis which is often small and stunted. Considerable discomfort may arise in the act of micturition owing to the urethral orifice looking downwards it is also sometimes so small as to require incision and dilatation. (c) Complete hypospadias or *hypospadia perinealis* is a somewhat complicated condition in which the lower wall of the urethra is defective as far back as the perineum the scrotum being cleft and thus resembling the vulva (Fig 843). The penis is always small imperfectly developed and bound down by adhesions between the scrotal segments looking not unlike a hypertrophied clitoris and late descent of the testes is common. Under these circumstances it is not surprising that the sex of the child has been mistaken and not a few cases are on record where the boy has been educated as a female until the age of puberty.

In the incomplete varieties, where the deformity is slight and the urethral opening well in front of the scrotum, no interference is necessary but where it encroaches on the scrotum, causing inconvenience and discomfort, and threatening to prevent effective sexual intercourse in the future, the restoration of the urethra may be attempted by the use of flaps obtained from either side, or from the redundant prepuce. In the complete form the penis must first be liberated from its adhesions and set free, the integument lining the scrotal cleft is then dissected up and turned inwards to form the posterior part of the urethra, and the lateral halves of the scrotum are brought together with sutures, the anterior portion of the urethra may then be dealt with, as for the incomplete variety.

Traumatic Laceration of the Urethra usually results from violence applied directly to the perineum, as by falling astride a stile, fence, or beam, it has also been caused by severe jolting in the saddle, or by a kick in the perineum. In fractures of the pelvis it may be produced by a spicule of bone puncturing the canal, and the membranous portion is that generally affected. The whole circumference of the urethra may be involved, the two segments being entirely disconnected, or only a portion may be ruptured, and that most frequently the floor.

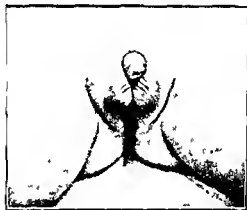


FIG 845 —COMPLETE HYPOSPADIAS WITH CLEFT SCROTUM

The **Symptoms** consist of pain in the perineum and shock, followed by great distension of the scrotum from hæmorrhage, and blood trickles from the urethral orifice. If the patient is able to restrain himself from passing water, and is successfully treated, no extravasation of urine results, since the lesion is below the sphincter vesicæ; if, however, he attempts to micturate, the urine finds its way into the perineal and scrotal tissues. Whether the rupture is complete or not, an organic stricture of considerable density is almost certain to follow, and great difficulty is subsequently experienced in keeping it dilated.

Treatment.—In the slighter cases, where it is probable that the mucous membrane has alone been torn, and there is no perineal swelling, the patient should be kept quietly in bed, and no attempts made at instrumentation. If urinary infection of the wound occurs, and an abscess forms, it can be dealt with by incision at a later date.

When, however, it is thought that the urethra is partially or wholly divided, no temporizing measures such as tying in a catheter, even if that be possible, should be adopted. An incision ought to be made at once into the perineum so as to expose the divided ends of the

urethra which it is the surgeon's aim to unite. The blood-clot is removed, bleeding points are secured, and if the ends of the urethra can be identified a soft catheter is introduced into the bladder, and they are sutured together around it with fine catgut. When the ends are much bruised they should be excised so as to have clean, smooth surfaces to deal with. Under any circumstances the catheter must be kept in for five or six days, and subsequently an instrument should be passed every day for some time. It is usually advisable to combine this with suprapubic bladder drainage to divert the urine from the damaged area; this also affords the opportunity for the retrograde passage of a catheter to identify the proximal end of the torn urethra.

If a catheter cannot be introduced, or if extravasation has occurred, free incisions must be made into the scrotum and perineum to give exit to the blood and urine, and to expose the seat of injury. A catheter is passed as far as possible, and its point felt for, cut down on, and guided into the bladder; a prolonged attempt under anæsthesia may be necessary to accomplish this, and even then it is useless to attempt to stitch up the urethra, as the sutures are certain to cut out. Occasionally, and especially if treatment has been delayed, the swelling of the parts is so great as to render the passage of a catheter impossible. The patient should then be drained suprapubically, and an attempt made as soon as possible to repair the urethral injury.

Foreign Bodies are sometimes found in the urethra, usually consisting of a portion of a catheter, pipe-stem, or in children a piece of slate-pencil. Their presence gives rise to partial or complete obstruction to the flow of urine, followed by ulceration of the mucous membrane, the formation of a peri urethral abscess, or even extravasation. They are readily detected on the passage of a sound or catheter, and may be removed by suitable forceps if situated near the orifice. Should this fail the urethra may be incised and the body extracted; a troublesome urinary fistula is apt to follow this proceeding, even when the wound in the urethra has been carefully sutured.

A pin is sometimes introduced voluntarily into the urethra, and is not easily removed, since it has usually been pushed in head foremost. The following manoeuvre is necessary in order to remove it. The point is made to penetrate the floor of the urethra and skin by a sharp push on the bead from behind. The body is pulled out until the bead catches against the mucous membrane, and then the direction of the pin can be changed so that the head presents at or towards the meatus.

Impacted Calculus is a not infrequent cause of retention in children. It can usually be felt through the walls of the canal. The symptoms and treatment are much the same as for foreign bodies. When near the neck of the bladder it should be pushed back into that viscus, if possible, and treated by lithotomy.

Simple Urethritis may arise from a variety of causes apart from gonorrhœa, e.g. the presence in the female of an irritating vaginal discharge, such as leucorrhœa, and possibly due to the *B. coli*. It also occurs after the passage of an instrument or of a calculus, and is occasionally excited in gouty individuals by highly acid urine charged presumably with spiculated crystals of uric acid. The symp-

toms are much the same as those of gonorrhœa, but the discharge is thinner in character, and on microscopical examination no gonococci are detected. The treatment consists in the administration of alkalies and saline purgatives, all forms of alcohol being interdicted. In more severe cases oleo-balsams may be prescribed, and even mild injections.

Polypoid Tumours, similar in character to the caruncle met with in the urethra of women, have been observed at the orifice of the male urethra. They are red, vascular, and sometimes exceedingly painful, and are dealt with by excision, followed by the application of the galvano-cautery so as to stop the bleeding, which is always copious. If of large size, the base may be ligatured and the growth cut away.

Epithelioma of the urethra is usually secondary to some other malignant development in the neighbourhood, *eg* of the prostate. Occasionally, however, it is primary, and then frequently the sequela of an old stricture. It constitutes a hard swelling of the urethra, which infiltrates surrounding parts, and there is usually some discharge of blood and pus from the meatus, micturition is consistently painful. The introduction of an instrument increases both the pain and bleeding, it generally passes easily, but the irregularity of the surface of the growth can be recognized. Examination by the urethroscope is desirable in such cases. Amputation of the whole penis is usually required.

Stricture of the Urethra.—By stricture of the urethra is meant a condition in which the onward passage of urine is hindered, owing to some change in the walls of the urethra, which prevents them from dilating. When at rest, the urethra is merely a potential canal, the walls of which are in complete apposition, and it is only converted into a tube when urine is passing along it. When, owing to some change in the structure of its walls, this functional dilatation is impracticable, the patient is said to suffer from stricture. Three forms of stricture are described, *viz* the spasmodic, congestive, and organic.

Spasmodic and Congestive Strictures frequently co exist, although either congestion or spasm may be the predominant feature in any particular case. Thus, in acute gonorrhœa the mucous membrane often becomes engorged and thickened to such an extent as to interfere with the act of micturition. Spasm is the chief element under the following conditions (1) When a patient suffering from slight organic stricture is exposed to wet or cold, especially after heavy drinking, (2) as a result of catheterism, and (3) from perineal irritation of the urethra, as by a blow or kick in this region, or from prolonged riding on a bicycle with a badly fitting saddle, or on horseback. Temporary retention is the usual result of any of these conditions, and, as a rule, no treatment is required beyond placing the patient in a hot bath, and unloading the lower bowel by the use of a large warm enema. If such fails, catheterism will be necessary, and must be conducted with the greatest gentleness, owing to the congested and lacerable condition of the mucous membrane. Full-sized soft instruments should first be used, and will usually succeed, if not, a silver instrument must be substituted.

Organic Stricture is the term applied to an undilatable condition of

the urethra, resulting from the development of cicatricial tissue within its walls.

The Causes of organic stricture are (a) The long continuance of a urethral discharge following gonorrhœa, or the frequent recurrence of this affection. Chronic inflammations are always characterized by a tendency to sclerosis of the tissues involved and the urethra is no exception to this rule, its walls under these circumstances becoming thickened, indurated and contracted. (b) The cicatrization of a urethral chancre, or of an ulcer caused by the impaction of a stone, or the contraction produced by the healing of a urethral abscess may also lead to stenosis. (c) The most intractable forms of stricture are those due to cicatrization after rupture or laceration of the urethral wall.

The usual Situation is within the bulb *e.g.* just in front of the triangular ligament, but the orifice and body are not infrequently affected. It occurs in the membranous portion only as a result of traumatism, and never in the prostatic. To find more than two strictures in any particular case is unusual, although three or four have been met with.

Various terms are applied to a stricture according to the physical conditions present, thus, it is termed *annular*, if it involves the whole lumen of the urethra, *bridled*, if it affects only a portion of the circumference of the tube. A *ribbon shaped* stricture is one in which a considerable extent of the wall is contracted, *i.e.* as if a ribbon has been tied around the urethra. It is termed *toruous*, if the resulting passage is not straight, *indurated*, if the walls are very hard and thickened, and *resilient*, when the stricture, though readily dilated rapidly recontracts. The terms *impassable* and *impermeable* are applied to strictures through which on the one hand, a surgeon is unable to pass an instrument, or along which, on the other hand, urine cannot find its way, it is doubtful whether the latter condition ever occurs, whilst the number of impassable strictures met with by the surgeon diminishes with his experience and ability in passing instruments.

The Symptoms of urethral stricture vary according to the case. The patient generally complains of difficulty in the act of micturition, the stream becoming small and perhaps forked or twisted. It takes a longer time than usual to empty the bladder, and even when apparently successful a few drops of urine may trickle away, wetting the patient's clothes. Irritability of the viscus follows leading to frequent attempts to pass water at short intervals during the day and night. The urine under these circumstances often becomes alkaline, and loaded with muco-pus and phosphates. As the obstruction increases more and more residual urine is left in the bladder, which may in time form a tense, rounded dull swelling in the hypogastrium. The quantity of urine trickling away also increases so that the patient's garments are always wet giving him an unpleasant urinous odour. A certain amount of gleet discharge is present, and if the individual takes an excess of alcohol or is exposed to wet and cold, complete retention may ensue. Sometimes the onset of symptoms is so insidious that such an attack of retention is the first marked feature in the case.

The Pathological Conditions arising from a stricture are best considered under the following five headings: (1) The urethra anterior to

the stricture is usually in a perfectly normal state although possibly the orifices of false passages may be seen. A few granulations are sometimes present projecting at the commencement of the stricture. (2) The *stricture itself* is characterized by the development of fibro-cicatricial tissue immediately under the mucous membrane, and intimately adherent to it. It extends for a variable distance and is often associated with a good deal of peri urethral infiltration. (3) The *urethra behind the stricture* is dilated and the mucous membrane velvety and friable, the orifices of the lacunæ and other glands are somewhat enlarged and more than usually evident, and ulceration may be present around them. In the later stages the inflammation may extend to the peri urethral tissues owing to lymphatic absorption or perhaps to the escape of a few drops of urine, a perineal abscess then results, leading subsequently to perineal fistulæ. When the obstruction becomes almost absolute, this portion of the urethra may give way, leading to extravasation of urine into the perineum and scrotum. (4) The *bladder* invariably manifests considerable changes in structure. At first the vesical wall undergoes a compensatory hypertrophy of its muscular elements and is thickened, in order to overcome the obstruction to the onward passage of urine (Fig. 846). The lattice work arrangement of the muscular bands becomes coarse thickened, and evident causing the vesical wall to assume a fasciculated appearance. As the pressure increases, the mucous membrane protrudes between the muscular fasciculi giving rise to sacculation, it is also thickened and congested as a result of chronic cystitis, the superficial veins become varicose and hæmaturia may be caused by their rupture, ulceration may also occur. The urine becomes alkaline and decomposes, containing muco pus and phosphates. It is likely to stagnate in any sacculi which exist and may then determine the formation of phosphatic concretions, or the walls of the sacculi ulcerate, and after a time perforation and extravasation of urine into the cellular tissue lead to a fatal issue. Occasionally the bladder, instead of being thickened, is dilated and atonic, with very thin walls. (5) Consequent on the changes in the bladder, the conditions already described as hydronephrosis, pyonephrosis, or pyelonephritis may develop partly as the result of the backward pressure, and partly from the extension of inflammation along the ureter to the pelvis of the kidney and calyces.



FIG. 846 — ANNULAR STRicture OF THE BULBOUS URETHRA

Physical Examination.—The actual diagnosis of a stricture can only be confirmed by a careful physical examination of the urethra, which is usually made by the introduction of a full sized catheter or a solid

bougie e.g. No 9 or 10 (English) so as to ascertain where the obstruction is situated. If this cannot be passed smaller instruments and even filiform bougies are inserted until one is found which will enter the bladder.

A great variety of catheters is in use in selecting such an instrument care must be taken that it is suitably curved that the eye is sufficiently large and bevelled inwards so that no projecting rim lacerates the urethral mucous membrane.

Catheters likely to be left and tied in should have more than one eye so that if one becomes blocked a drain is still established through the other.

The great advantage of silver catheters is that they can easily be rendered aseptic and the point can be located and guided readily along the urethra.

Many varieties of flexible catheters are now extensively employed as they give rise to less irritation than those made of metal and are less likely to traumatize the urethral mucous membrane. They are not readily directed through a stricture on account of this flexibility and their use has been largely replaced by bougies for this condition.

The most advisable way of sterilizing gum elastic catheters is by



FIG. 846A.—TIEMANN'S CATHETER

keeping them in a box with formalin tablets. The catheters however must be washed through with weak boracic or sterile water to remove deposit of formalin from the interior and exterior of the catheter as this substance readily sublimates and is very irritating. Alternatively they may be allowed to soak for twenty minutes in a 1 : 2 000 sublimate solution.

The most popular rubber catheters are Marshall's or Tiemann's (Fig. 846A) the latter being useful in prostatic cases as it is made of particularly firm rubber and its beak is coude to engage the curve of the urethra.

Bougies or solid instruments are preferred by the majority of surgeons for examination and treatment of strictures. Lord Lister's are still popular consisting of solid metal rods curved like catheters the bulbous ends of which are three sizes smaller than the shanks thus enabling each instrument to prepare the way for the next.

If these fail to pass a filiform bougie made of gum elastic is introduced. If this fails several more are introduced simultaneously into the urethra and each will block up a pit or even a false passage so that ultimately one will find its way through the stricture. When this has been done a Harrison's bougie can be screwed on to the connection at the end of the filiform bougie which will then guide the passage of the larger instrument. If necessary a Phillips catheter which is similar in design except that it has a lumen for the drainage of urine can be used if a full bladder is present.

In order to introduce a silver catheter or bougie the patient is laid

on his back the surgeon standing on his left side. The umbilicus should always be exposed as also the upper parts of the thighs. The meatus and end of the penis are washed with a 1 in 2 000 solution of sublimate as also the surgeon's hands. The catheter which has been previously sterilized warmed and covered with sterilized or antiseptic oil or grease is taken in the right hand and inserted into the urethra with the handle directed over the left thigh and slightly downwards. The point of the instrument is guided as far as the perineum and then the handle is carried round to the middle line of the body towards the umbilicus it is gently raised to the vertical the penis being held in the left hand and finally depressed between the patient's thighs the so called *tour de maître*. The catheter finds its way along the urethra into the bladder rather by its own weight than by any forcible action of the surgeon. The chief points at which difficulty may be experienced are (a) The orifice which may be small and contracted (b) the lacuna magna which is avoided by keeping the point of the instrument against the floor and (c) the opening in the triangular ligament which is best entered by keeping the point against the upper wall of the canal.

When a flexible instrument without a stylet is used it is passed by pressing the point on with a little rotatory movement until the bladder is reached withdrawing a little and pushing on again if any obstruction is met. In some instances however the use of a stylet is absolutely necessary.

The chief Dangers of catheterism are as follows

1 A considerable degree of shock is sometimes experienced especially in sensitive individuals and if an instrument has not been passed before. It may be obviated to a large extent by first introducing about $\frac{1}{2}$ drachm of the 5 per cent solution of novocaine into the urethra.

2 *Hæmorrhage* may be induced by laceration or abrasion of the mucous membrane even though no false passage has been made it is best avoided by gentleness and the use of well finished instruments. In spite of these precautions when the mucous membrane is soft and congested and in many cases of stricture some bleeding cannot be avoided. It is rarely sufficient to call for special treatment but if very abundant may be arrested by the pressure of an instrument tied in or by injections of hazeline.

3 *False passages* are occasionally produced in the treatment of strictures. The point of the instrument is most likely to leave the canal at some spot in the floor travelling for a variable distance according to the force employed under the mucous membrane sometimes re-entering the dilated urethra behind the stricture which it avoids altogether or perforating the posterior wall of the bladder by tunnelling under the prostate an accident which can only occur in unskilful hands. The occurrence of a false passage is indicated by the sudden onward movement of the instrument combined with pain and hæmorrhage the point is usually deflected from the middle line as is plainly seen by the obliquity of the rugæ at the end of the shaft no urine comes unless the urinary passages are opened behind the stricture. On rectal examination the instrument can be felt out of the middle line and nearer the rectum than is normal and in some exceptional cases has even

been found in it. A false passage is not necessarily a matter of great importance, but when extensive may lead to peri urethral suppuration and extravasation of urine. If the urine is very offensive, grave infective troubles may arise even threatening life. Thus in one case the unfortunate patient suffered subsequently from gangrene of the penis, necessitating its almost complete removal, in spite of the fact that a free incision was made through the perineum into the urethra, and the urine drained away.

4 Inflammatory phenomena may be lighted up in the prostate, and acute epididymitis induced by extension along the vas deferens, these are always due to infection.

5 Urinary Fever, or as it is sometimes termed, urethral or catheter fever, is always liable to develop as a result of the introduction of instruments. It may occur as a solitary rigor even in individuals with healthy urinary organs, but is much more frequently observed in those with damaged kidneys. As to its causation, much discussion has arisen but there can now be little doubt that it is essentially infective in origin. Possibly the instrument employed may be dirty, or the urethra itself contains infective material, especially in its deeper parts. It is quite sufficient for a slight abrasion to occur near the neck of the bladder to allow of the absorption of bacteria, and then general phenomena show themselves at once. Possibly a passing febrile condition, with one or more rigors will develop with no more serious phenomena, but the trouble is liable to extend from the bladder to the kidneys, giving rise to pyelonephritis.

The *clinical manifestations* vary considerably, according to the character of the case and the type of infection. (a) The simplest form consists in the development of a single rigor the temperature perhaps running up to 105°F , the patient shivers and feels very ill, complaining of headache, but when the temperature falls he soon recovers and within a few hours is all right again. (b) Sometimes the temperature does not fall to the normal after the initial rigor, but remains elevated a few degrees for a day or two, and there may even be a repetition of the rigor. The patient however, recovers perfectly and no permanent harm is done. (c) In the more serious cases the symptoms of pyelonephritis supervene and are very likely to prove fatal the patient perhaps dying in seven or eight days. (d) General pyæmia may appear as a complication of the last condition. (e) In patients who are commencing the regular passage of catheters for enlarged prostate a series of phenomena develop which have been already alluded to (p. 1429) and though often mild, are of a similar nature. (f) Finally suppression of urine may accompany any of the conditions alluded to above.

Treatment—The greatest care must always be taken in order to avoid infection and it is better to use soft instruments if possible, rather than silver ones as the latter give rise to more irritation than the former and are more likely to abrade the mucous membrane.

For the single rigor following catheterism the patient must be kept warm plenty of hot diluent drinks given and quinine (2 grains) administered. If the febrile symptoms continue the skin and bowels

are freely acted on, and a milk diet prescribed, although a certain amount of stimulant may be given if necessary, all operative measures must be avoided, unless it is essential to relieve obstruction. If suppression of urine ensue the loins should be cupped in the hope of relieving renal congestion, and a free action of the bowels obtained by the use of watery purgatives. If the urinary secretion is not quickly re-established, i.e. in forty eight hours, the surgeon should perform nephrostomy i.e. opening and draining the renal pelvis, without delay selecting for operation the kidney which appears to be most tender. It may be necessary to incise both kidneys. Uræmic symptoms may sometimes be relieved by copious and repeated intravenous injections of saline solution, which encourage diuresis and a watery diarrhœa.

The Treatment of Passable Strictures is conducted either by dilatation or by a cutting operation (internal or external urethrotomy).

Treatment by Dilatation is effected in various ways, according to the nature of the stricture and the urgency of the symptoms. Where the obstruction is not serious, and an instrument can be easily passed, *gradual dilatation* should always be employed, this consists in the use of instruments once or twice a week, steadily increasing in size until a No. 12 is reached. If the intervals are too short, the urethra may become irritated, spasm be induced and the lumen of the canal temporarily diminished in size, by keeping the patient quiet for a few days on a bland diet, and the bowels freely open, the spasm disappears. In cases where time is an object *rapid dilatation* may be undertaken by the passage of several sizes of bougie at one sitting, for this purpose Lister's instruments are particularly useful. Where only a very small catheter can be introduced, and that with difficulty, *continuous dilatation* may be adopted by keeping the patient in bed, and tying in a small instrument for forty eight hours or more, at the expiration of which period a catheter several sizes larger can be substituted. This in turn may be tied in if the patient can bear it, but the presence of a catheter within the urethra for any length of time is not always tolerated, and may give rise at the end of two or three days to considerable constitutional disturbance and fever.

By whichever of these methods dilatation is accomplished, it is essential that either the surgeon or the patient should subsequently pass an instrument through the stricture, at first every week or two, and then at longer intervals, to overcome the tendency to recontraction which is ever present.

The Treatment of Passable Stricture by a Cutting Operation is conducted either by excision or by internal or external urethrotomy.

Excision is certainly the ideal treatment, the urethra being thereby restored to a normal condition. It has now been frequently undertaken, and with great success, in strictures of the deeper perineal portion of the urethra, it is not so satisfactory when the penile urethra is involved. Fully an inch of the tube may be excised, and the ends sutured together over a catheter. The corpus spongiosum must be detached from its surroundings to permit of this. Sutures are introduced in the upper wall first, then the catheter is placed in position, and the remainder of the stitches inserted.

Internal Urethrotomy is a valuable means of treatment when rightly employed but in careless or inexperienced hands may be attended with considerable danger. It should never be undertaken for impassable strictures and therefore it is limited to strictures through which at least a filiform sound can be passed, and yet for various reasons ordinary dilatation is undesirable. Thus it may be required (a) in the treatment of very old and dense strictures as also (b) for resilient strictures and (c) when the urethra is so irritable that the passage of any instruments is associated with grave constitutional

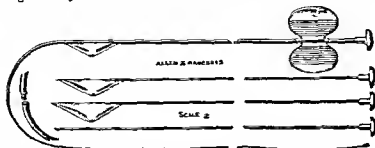


FIG 847—SIR JOHN THOMSON WALKER'S URETHROTOME.

reaction (d) Occasionally the patient cannot give the time to submit to ordinary treatment by dilatation, and in order to hasten matters, internal urethrotomy may be desired.

The operation is usually performed from before backwards and Thomson Walker's urethrotome (Fig 847) is usually employed. After irrigating the urethra a special staff is introduced to which is attached terminally a fine filiform guide, which passes through the stricture and coils up in the bladder. Along a groove in the staff is inserted a steel



FIG 848—SYME'S SHOULDERED STAFF FOR EXTERNAL URETHROTOMY.

rod carrying a triangular knife, sharp at each end and with the apex blunt and expanded, so as not to injure the urethral wall during its passage. When the knife engages the face of the stricture its onward progress is hindered and then the surgeon drives it forward with a sharp push thereby dividing the fibrous wall of the stricture, this is usually effected along the roof of the urethra. Several sizes of knife are available so as to vary the depth of the incision. A full-sized soft catheter is passed and tied in being retained for two or three days the patient is then permitted to micturate normally, and no instrument is passed for a fortnight. Hemorrhage sometimes occurs as a sequela,

and is not easy to control ice to the perineum and pressure may be helpful, or calcium lactate may be given *per rectum*, in serious cases perineal section may have to be undertaken and direct pressure applied.

External Urethrotomy, or Syme's Operation, is required under circumstances similar to those needing internal urethrotomy, but is chiefly employed when complications arise behind the stricture such as a perineal abscess perineal fistulæ, impaction of a calculus or extravasation of urine. It is performed by passing a special shouldered



SCALE 3

FIG 849 — WHEELHOUSE'S STAFF

staff (Syme's Fig 848) the distal end of which is small enough to traverse the stricture, and grooved in the middle line the shaft of the instrument is of larger size and ends abruptly, so that the shoulder rests against the face of the stricture the groove extends on to the larger portion for about $\frac{1}{4}$ inch. The patient is then placed in the lithotomy position, and the surgeon seated opposite the perineum, which is shaved and purified incises it in the middle line deepening his dissection carefully so as to reach the groove in the staff behind the stricture. The knife is then carried forwards to the anterior extremity of the groove and inasmuch as it extends on to the shaft of the instrument, the stricture is completely divided. Any fistulæ which exist are laid open into the median wound. A full sized soft catheter is then passed into the bladder, through either the penis or the perineum, according to circumstances, and retained in position for some days the urine being syphoned off in the usual way, the perineal wound, after hæmorrhage has been stopped is packed and allowed to heal by granulation. The catheter is removed early or late according to the amount of general disturbance caused thereby, and subsequently a full sized instrument can be passed into the bladder daily.

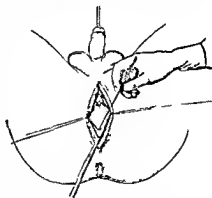


FIG 850 — WHEELHOUSE'S OPERATION FOR IMPASSABLE STRICTURE

The Treatment of Impassable

Stricture varies according to whether or not the condition is complicated with retention of urine.

If no retention is present, it is possible that the inability to pass an instrument is due to some temporary spasm or congestion induced by errors of diet or drink, or perhaps by exposure to cold. Hence the patient should rest in bed for a few days, his bowels be well opened, the diet regulated, and a mixture containing some alkaline purgative and tincture of henbane administered. Further attempts at instrumenta-

tion should then be made if necessary under an anæsthetic and if the stricture still remains impassable *Wheelhouse's operation* (Fig. 850) is indicated. This consists in incising the urethra in front of the constriction tracing the passage backward, and dividing it. A Wheelhouse's straight staff (Fig. 849) with a median groove and a blunt hook at the end is inserted down to the stricture and the urethra opened just in front of it by cutting down on the groove. The staff is then twisted round, the upper end of the incision drawn up by the projection of the hook, and the sides of the urethra held apart with artery forceps. The orifice of the stricture is thus exposed, and granulations may often be seen projecting from it. A fine probe-pointed director can generally be insinuated along the urethra through the stricture, which is then divided. A full sized instrument is passed into the bladder and retained for a few days, and the wound is allowed to heal by granulation.

If *retention of urine is present* in a case of impassable stricture, no time must be lost. If seen at an early stage and the symptoms are not urgent, the patient is given a hot bath, and the bowels are opened by a warm enema, whilst a moderate dose of opium or preferably a morphia suppository is administered. If the urine is not passed naturally in the bath and the bladder is becoming distended, being felt in the lower part of the abdomen, then suprapubic cystotomy must be performed, and bougies or soft instruments passed from inside the bladder if not at once, at any rate after a day or two. Dilatation then proceeds in the usual manner.

The chief complications of stricture other than those already mentioned are *peri urethral abscess* and *extravasation of urine*.

A *Peri urethral Abscess* is due either to a limited extravasation of urine, or to the absorption of infective material through an ulcerated surface. It is indicated by the formation of a hard, brawny swelling in the perineum or above the scrotum, which is tender to the touch. As it approaches the surface fluctuation can be detected, and the skin over it becomes congested and oedematous. Constitutional disturbance and fever of an asthenic type are also present. Left to itself it bursts and usually gives rise to a perineal sinus or fistula, discharging either pus or urine mixed with pus. One or many of these fistulae may occur, and the openings are not limited to the perineum, but may also be found in the thighs or buttocks. In chronic cases, the scrotal or perineal tissues become infiltrated and of an almost cartilaginous consistency.

Diagnosis.—Every abscess in the scrotum or perineum is not necessarily associated with stricture, for simple irritation of the skin may lead to a superficial abscess, suppuration in the lacunae or Cowper's glands may follow gonorrhoea, a prostatic or ischio-rectal abscess may point in the perineum, and the injury inflicted by the passage of instruments, or the existence of false passages, may lead to a similar result.

Treatment consists in letting out the pus through a free incision, and it is often advisable to take the opportunity of dealing radically with the stricture by section at the same time. Perineal fistulae can rarely be cured without operation, since, although the stricture may

be completely dilated, the discharge of urine and pus continues. In these circumstances Syme's or Wheelhouse's operation is the proper treatment.

Extravasation of Urine is a condition due to a solution of continuity of the urethral walls, allowing the urine to find its way into the perineal and scrotal tissues. It usually results from over distension of the urethra behind a neglected stricture, during some violent effort at micturition, the patient experiences severe pain and a sensation as if something had given way in the perineum, followed by a feeling of relief. This, however, is of short duration, as it is soon succeeded by the local and constitutional effects of extravasation. Occasionally the onset of symptoms is more gradual, being preceded by a peri urethral abscess, which bursts into the urethra, at each act of micturition the cavity becomes more and more distended with urine, finally the wall yields, resulting in diffuse extravasation. The same phenomena are produced in cases of traumatic laceration of the urethra if the patient attempts to empty his bladder.

The membranous urethra is almost always the site of the rupture, the urine finding its way subsequently through the anterior layer of the triangular ligament and being guided towards the anterior abdominal wall by the arrangement of the fasciæ. The root of the penis, covered by its appropriate muscles, lies in an interfascial cul de-sac, formed by the anterior layer of the triangular ligament above and the deep layer of the perineal fascia (or fascia of Colles) below, these two layers are continuous passing round the transversus perinei muscles, and are both attached laterally to the ischio-pubic ramus. Into this space the urine finds its way, after the anterior layer of the triangular ligament has yielded, and owing to the fact that its passage backwards and laterally is checked by the attachment of the fasciæ, it is necessarily forced forwards, infiltrating in order the perineum, scrotum and body of the penis. If more extensive, it travels along the spermatic cords to the anterior abdominal parietes, its passage downwards into the thighs being prevented by the attachment of the deep layer of the superficial fascia of the abdomen to the fascia lata just below Poupart's ligament. In the most severe cases the urine may even find its way as far as the axillæ.

The Effects of extravasation of urine following a stricture are always serious, inasmuch as it is almost certain to be foul and alkaline, and hence wherever it travels it gives rise to a gangrenous cellulitis. The parts at first become infiltrated and brawny, but soon necrosis of the cellular tissue occurs. The congested and œdematous skin turns to a dusky purple or black colour, and finally gives way or separates, allowing exit to a mixture of pus, urine, and decomposing slough of a most offensive and penetrating odour. The superficial loss of substance may be so extensive as to lay bare both testicles, and even the body of the penis, or part of the anterior abdominal wall. The inflammatory process is necessarily associated with severe constitutional disturbance, at first characterized by high fever and a quick, bounding pulse, but later on the temperature may become subnormal and the patient profoundly collapsed from toxæmia.

The Treatment consists in early and free incisions so as to give exit to the urine and pus, and to prevent, if possible, the sloughing of the skin and subcutaneous tissues. Every part that the urine has infiltrated must be dealt with in this way, thus the perineum should be incised in the middle line, the scrotum is similarly divided if need be, down to the urethra the testicles being laid on either side, but, if possible this should be avoided. The penis should be incised, when necessary on either side of the urethra, and along the dorsal surface. It is often possible to expel a large portion of the urine, especially in the scrotum by firmly squeezing the infiltrated tissues. A full sized catheter must be passed into the bladder, and to effect this the urethra has often to be laid open and the stricture divided, perineal drainage is always preferable for these cases. The parts should be subsequently dressed with gauze soaked in flavine, eusol, or hypertonic saline solution. Frequent hip-baths may be employed, and a continuous sitz bath is very valuable for a short time. As soon as the wounds become clean, they should be dressed in the ordinary way to allow them to granulate. The general health of the patient must of course be attended to, plenty of easily assimilated nourishment, stimulants, and quinine being administered.

Affections of the Penis.

Phimosis, when complete is a condition in which the prepuce is so long and the orifice so narrow, that it cannot be retracted behind the corona. It is usually Congenital in origin and may exist to such a degree as to render micturition impossible. More frequently the opening is a very small one (pinhole prepuce), permitting micturition, but leading to irritability of the bladder from the obstruction. In such cases the prepuce is usually adherent to the glans, and considerable irritation is caused by the retention of the smegma secreted by Tyson's glands this may collect and become so inspissated as to give rise to definite concretions. The child pulls at the foreskin, owing to the itching produced, and thus a symptom of vesical calculus may be simulated. Attacks of balanitis are also frequent, and should the prepuce be withdrawn paraphimosis is almost certain to follow. If allowed to remain untreated long enough distension of the bladder, and even hydronephrosis may supervene. This condition is often provocative of masturbation, and is certain to aggravate the symptoms of venereal disease there is but little doubt that it acts as a predisposing cause to epithelioma of the penis. Phimosis also occurs as an Acquired condition resulting from the cicatrization of venereal sores.

The Treatment of phimosis consists in circumcision. Other methods have been suggested, e.g. dilatation of the prepuce, and merely slitting it up but they are not satisfactory.

Circumcision should always be performed on children with a long prepuce within the first year of life since at that time the parts are but slightly developed, the operation is a trifling one and but little inconvenience is subsequently experienced the longer it is postponed, the more troublesome does it become. The best method of operating is as follows. The dorsal aspect of the prepuce is put on the stretch by

grasping it on either side of the median line with a pair of catch forceps a director is then introduced between it and the glans, and held exactly in the middle line, and the prepuce slit up with a curved pointed bistoury or scissors. The lateral halves are now separated from the glans, adhesions, if necessary, being broken down, so as to enable all retained smegma to be removed, and the corona glandis defined. The redundant preputial tissue, both skin and mucous membrane, is cut away on each side by scissors, special attention being directed to the removal of sufficient tissue on the under side to prevent the unsightly projection so liable to follow. In adults several arteries will require to be ligatured, especially that in the frænum, but in a child the hæmorrhage is trifling. Having carefully trimmed up the edges and snipped off ragged corners, so as to render the margins of the wound regular, catgut sutures are inserted to prevent any raw surface being left exposed in children only a few are required, but possibly a considerable number in adults, a continuous suture should never be employed. The wound is dressed with strips of gauze, and around this a wisp of sterile wool, retained in adults by a narrow bandage. Considerable after-trouble is sometimes experienced from nocturnal erections, which may be so marked and prolonged as to tear through the stitches to control this the patient's bowels should be freely opened, and he should be kept on a low and unstimulating diet, and bromide of potassium or other sedatives administered. The stitches are usually removed at the end of five days, and the parts are then dusted over with a mixture of powdered boric acid zinc oxide, and starch so as to reduce their sensitiveness.



FIG 951.—REDUCTION OF PARAPHIMOSIS

When a phimosed prepuce is completely retracted, the patient often finds it impossible to replace it, thus giving rise to a condition known as Paraphimosis. It is due to the narrow orifice of the prepuce getting behind the corona, and is characterized by great œdema and congestion, not only of the exposed mucous membrane, but also of the glans itself. If left untreated, ulceration takes place along the line of constriction, and the parts become fixed in their deformed position, the vessels sooner or later accommodating themselves to the new conditions, and the œdema slowly disappearing. In some cases sloughing of the glans may occur.

Treatment consists in forcible replacement of the prepuce. This is accomplished by grasping the penis between the first and second fingers of each hand, and compressing the glans penis with the thumbs so as to empty the vessels and diminish the amount of œdema present, and thus reduce its size (Fig 851). At the same time the fingers draw the prepuce forwards, and thus finally reposition is effected. When the œdema of the prepuce is very marked, it should be punctured in several places to permit the escape of serum and diminish the tension, previous

to reduction as just described. In more advanced cases reposition becomes impossible and then the narrow constricting band caused by the orifice of the prepuce must be divided on the dorsal aspect. This will free the parts which can be subsequently drawn forwards and after the oedema has been reduced by applying *lotio plumbi* for a few days circumcision may be advantageously undertaken.

Balanitis, or inflammation of the glans may be simple in nature, arising from want of cleanliness in a person with a long foreskin but is more frequently associated with gonorrhœa or soft chancres. The under surface of the prepuce is often involved and then the term *Balanoposthitis* is sometimes applied to it. A purulent discharge escapes from under the prepuce which is often swollen and oedematous. Occasionally when a considerable degree of phimosis exists the under surface of the prepuce may become ulcerated and even perforated, allowing the glans to protrude through its upper surface.

Treatment.—In simple cases all that is required is to cleanse the parts thoroughly by washing beneath the foreskin and then to apply lead lotion on lint between the glans and the prepuce but when there is much discharge and the foreskin is long and swollen or if perforation is threatening the prepuce must be slit up and after the parts have been restored to a healthy state, the redundant tissues should be cut away by a modified circumcision.

For Soft Chancre and Syphilis, see pp 131 and 138.

Herpes not uncommonly affects the prepuce and glans. It may result from simple local irritation more



FIG 852.—GONORRHOËAL WARTS

especially in gouty individuals but is most frequently seen in patients who have suffered from syphilis and is then likely to be somewhat intractable. It manifests itself as a crop of small vesicles on a hyperæmic base which become abraded leaving a number of small ulcers. It is preceded by neuralgic pain and accompanied by much itching and irritation. The only treatment required is to keep the parts clean and dust them over with powdered oxide of zinc and starch. In the majority of cases the disease lasts from a week to ten days.

Warts (Fig 852) often arise on the penis in the shape of red, vascular excrescences usually pedunculated and sometimes of considerable size. They are met with most frequently as a sequela of gonorrhœa and must be carefully distinguished from mucous tubercles. They should be treated by snipping away with scissors and cauterizing the base with a galvano-cautery. The X rays are also useful in their removal when very extensive.

Horns are also occasionally seen arising from the body of the penis. They are of the usual sebaceous type, as described at p 460 and should be excised.

Epithelioma of the penis rarely arises except in patients who are the subjects of congenital phimosis or possess long foreskins, and hence is said to be unknown amongst the Jews. It usually commences in the sulcus behind the corona glandis, and rapidly spreads to the surrounding parts, manifesting itself either as an irregular papillated, wart like outgrowth or as a diffuse infiltration ulcerating early, and leading to considerable destruction of tissue (Fig 853). At first the prepuce becomes distended, producing a sanious discharge which contains epithelial cells as well as pus corpuscles, but later on both the prepuce and the body of the penis are invaded, and, owing to its great vascularity, the disease makes rapid progress. The inguinal glands are early affected, but when the body of the penis is involved, the lumbar glands are also implicated.

Treatment consists in amputation of the penis whenever the disease is sufficiently limited to lead to the hope that it can be eradicated. When confined to the distal end of the organ, the operation may possibly be performed through the body, but it is much more logical and more in accord with modern scientific dicta to remove the whole organ. The lymphatic field connected with the penis ought also to be cleared, as in any other case of cancer. This is not difficult to effect as regards the inguinal glands, but is impossible as regards the pelvic or lumbar glands. Oblique incisions are made in either groin, and through these the glands, together with the vessels and fat surrounding them, are gathered up and turned down and in towards the root of the penis, where, if the amputation is to be total, they can be taken away together with the body of the penis in one portion, without division of the lymphatic trunks. Unfortunately, lymphatic œdema of the legs may develop after this procedure if it be thorough.

During the last few years radium has been used in the treatment of carcinoma of the penis, and has given excellent results. Suprapubic cystostomy is required before radium can be used. The primary growth in the penis is surrounded by small radium needles, which are left *in situ* for eight to ten days, the dosage being about 2,000 mg hours. The inguinal glands are treated by Columbia paste plaques, each containing about 30 mg of radium. These plaques are applied to the groins eighteen hours each day for a period of twenty days, the dosage aimed



FIG 853.—EPITHELIOMA OF PENIS
(KING'S COLLEGE HOSPITAL MU-
SEUM)

at being 14 000 mg hours. The suprapubic cystostomy is allowed to heal after the radium treatment is completed.

Amputation through the body of the penis is an operation of but little difficulty. The skin around the organ is divided by a circular incision and retracted a little. The corpora cavernosa are then cut through and the corpus spongiosum divided half an inch lower down. Bleeding is arrested by securing the divided vessels: five ligatures are usually required, viz. one for the artery to each corpus cavernosum, one for each dorsal artery, and one for the artery to the septum. The fibrous sheaths of the corpora cavernosa are then overstitched, so as to close the vascular spaces, and the urethra split on its inferior aspect for about a centimetre. The skin on the under side of the penis is similarly incised in a longitudinal fashion, and the urethral mucous membrane is stitched to it. The remainder of the incision is closed in the usual way.

Amputation of the whole penis is a more serious operation. The patient is placed in the lithotomy position, and the perineum after being shaved and purified, incised freely in the middle line. The corpus spongiosum is traced backwards, and divided at such a level as to allow the mucous membrane lining the proximal portion of the urethra to be stitched to the skin at the posterior angle of the incision. The corpora cavernosa are freed from their connections and separated at their origins from the ischio-pubic rami by the knife or suitable raspatories. An elliptical incision is then made round the root of the penis, the dorsal vessels are divided and secured, and the suspensory ligament cut through. The penis can then be drawn forwards, and by a few final touches of the knife completely removed. All bleeding points are ligatured, and the anterior wound closed by a continuous suture in the middle line, a drainage-tube being placed in the perineal portion for a few days. The results of this operation have on the whole been very satisfactory, and by the use of a suitable contrivance the patient need not assume the sitting posture in order to micturate. He will require to carry about with him a small metal funnel, bevelled to fit the perineum, and with a spout directed forwards. An excellent one was extemporized by a patient from the rose of a watering-can, the perforated top having been removed and the edges smoothed and bevelled.

CHAPTER XLVI

AFFECTIONS OF THE TESTIS, CORD, SCROTUM, AND SEMINAL VESICLES.

Congenital Affections of the Testis—It is scarcely necessary to state that the testicles are not developed in the scrotum, but from the posterior wall of the abdominal cavity so that they lie at first behind the peritoneum close to the kidneys. The body of the gland arises from the so-called genital ridge, which is covered by columnar epithelial cells, and lies to the mesial side of the Wolffian body. The vasa efferentia are developed from the tubules of the latter structure, coming into relation at a later date with the seminal tubules. The vas deferens is formed by the Wolffian duct.

Occasionally the body of the testis is entirely absent, and a few cases are on record of absence or deficiency of the vas. Very rarely two testicles have been developed on one side, and have both found their way into the scrotum (*polyorchism*).

The passage of the testis from the abdominal cavity to the scrotum takes place at about the end of the eighth month of intra uterine life. The gubernaculum testis assists in this process, but whether its function is to direct or to effect the descent is still somewhat doubtful. It consists of a band of involuntary muscular fibres which traverses the inguinal canal, and is attached above to the posterior peritoneal wall of the abdomen and possibly to the testis, and below to the abdominal wall, to the pubis, and to the bottom of the scrotum. The gubernaculum is supposed to exert traction on the testis and peritoneum, thereby determining the formation of the tunica vaginalis in the first place, and the descent of the testis slightly later.

Two chief forms of malposition of the testis are described arising either from its incomplete or abnormal descent.

I Incomplete Descent or Retention of the Testis—The testis may remain in the abdominal cavity attached to the abdominal wall by a mesorchium (*retentio abdominalis*), more frequently it is found just within the internal abdominal ring (*retentio iliaca*), but most commonly it occupies the inguinal canal, or lies just outside of it (*retentio inguinalis*). The organ in the latter position is freely mobile, being readily pressed up towards the abdominal cavity. The cause of this condition must be looked for in some defective action of the gubernaculum. It is easily recognized by the absence of the testicle in the scrotum, and in the inguinal variety the organ can usually be detected as a small movable swelling about the size of a horse-bean. The scrotum on the affected side is imperfectly developed. In any of these varieties a late descent of the testis may occur, usually accompanied by a congenital hernia, possibly of an interstitial type.

2 Malposition of the Testis.—Two chief forms are described (a) *Ectopia Perinealis*—In this variety the testis finds its way into the perineum slipping along the groove between the thigh and the scrotum. It may exist as a congenital condition or may follow a late descent of the testicle and always causes considerable inconvenience to the patient especially on sitting or riding. (b) *Ectopia Cruralis*—The testicle here lies on the inner side of Scarpa's triangle in the region of the saphenous opening. It is said to escape along the crural canal but more probably it passes down the inguinal canal as usual and then finds its way over Poupart's ligament to this situation. When as not uncommonly happens a congenital hernia also exists it may travel outwards to the anterior superior spine being directed there by the arrangement of the fasciæ as in a femoral hernia (extra parietal interstitial hernia p. 1284).

In cases of retained or misplaced testis the spermatogenic function of the organ is rarely developed or at most merely for a year or two about the age of twenty. Pain is not unfrequently complained of coming on in attacks which last for a short time and then disappear probably due to slight injuries or torsion. Fibrosis of the testis follows in time and total degeneration is the ultimate outcome. If only one organ is affected but little harm follows but if both are involved the individual is probably sterile.

Complications of a Retained or Misplaced Testicle—Any of the conditions to be described hereafter in this chapter may involve a retained or misplaced testicle just as if it were in the scrotum and give rise to considerable trouble especially when the organ is lying in close proximity to the peritoneum. A testis misplaced or retained in the inguinal canal is much exposed to injury and a subacute traumatic orchitis often occurs. It is stated that such organs are very prone to become the seat of malignant disease at a later period of life.

Treatment—Most promising results are obtained by either endocrine or surgical measures between the ages of six and twelve rather than leaving the patient to attain the age of puberty in the hopes that some further descent may occur. Endocrine treatment consists of giving injections of Pregnyl or some allied substance which undoubtedly does encourage descent in about one-third of the cases. The usual dose is about 500 rat units given intramuscularly. It is said that in some cases this treatment tends to produce premature and precocious development. Injections are given twice weekly up to a dozen.

Operation—Orchidopexy—The principle of all operations for orchidopexy is firstly to elongate the cord without damage to the spermatic vessels by dividing fibrous and muscular bands and by straightening its tortuous path. The fixation of the testis to the bottom of the scrotum may be done by one of three methods.

Ombredanne's operation consists in making a small incision in the scrotal septum and passing the testis through to the opposite scrotal compartment.

Torek's operation consists of fixing the testis to the fascia lata of the thigh and sewing the skin of the scrotum to the edges of this

wound which is separated by a second operation some three or four months later

Thirdly maintenance of the testicle in the scrotum by means of a twisted silver wire splint fixed above to the periosteum of the pubis and stitched to the tunica albuginea at the bottom end. This splint is removed in about fourteen days by making a small cut over its projecting lower end

In any of these three operations the important part is care in dividing the coverings of the cord paying particular attention to the spermatic vessels and in cases of bilateral maldescent only one side should be done at a time

Orchidectomy—If the one testicle is fully descended into its scrotal compartment and at operation on the maldescended side difficulty is experienced in obtaining sufficient length of spermatic cord to allow reposition in the scrotum orchidectomy would seem indicated as sufficient internal and external secretion would be available from the healthy side

In all these operations attention must be paid to any hernial sac which is frequently present which must be dissected off the cord and its neck transfixed and tied off in the usual way

Another condition met with congenitally is Inversion of the testis, the epididymis lying in front, and the body of the organ behind. It is of no clinical significance, except that in careless hands the testis may be injured in tapping a hydrocele

Torsion of the Spermatic Cord results in acute strangulation of the testis. The cause still remains unknown but several of the cases recorded have been associated with late descent of the testicle, and others have been attributed to twists and strains. The symptoms are tolerably characteristic the patient complains of an acute sickening pain in the testis which persists until gangrene has supervened, and may then disappear. It is accompanied by a certain amount of pyrexia, and the appearance of a tumour either in the inguinal region or in the scrotum. The testicle, slightly enlarged is felt below, and above it a larger mass consisting of the twisted cord and the congested and swollen epididymis. In some cases the latter swelling has been crepitant, owing to the development of gases due to its putrefaction. The condition is very likely to be mistaken for a strangulated hernia, which it closely resembles, but the presence of fever and the absence of abdominal distension and of faecal vomiting are important distinctive signs, moreover, constipation, though often present is never absolute. If the testis is situated in the scrotum, the cord and inguinal canal are found to be clear, but if in the canal, the affected side of the scrotum is empty. The only Treatment possible is exploration and removal of the inflamed or gangrenous testis and cord unless the case is seen very early, when it may be feasible to untwist it

Injuries of the Testis and Cord.—Contusion is a very common form of injury. It arises from blows, kicks, squeezes, and the like, and is always associated with immediate pain of a most sickening and intense character, which is not only experienced in the testicle, but also radiates along the cord towards the loins and back, and down the front of the

thigh. Severe shock accompanies the pain, and may be so profound as to lead to a fatal issue. A well marked traumatic orchitis often follows, and this may in turn cause atrophy of the organ although the same condition sometimes occurs without much evidence of inflammation as a result of thrombosis and occlusion of the spermatic vessels. A hæmatocele is also induced by a subcutaneous lesion of this nature. Treatment consists in keeping the patient in the recumbent posture with the scrotum well raised, and in applying fomentations or an icebag.

Penetrating Wounds or Punctures are uncommon except as a result of surgical treatment, *e.g.* tapping a hydrocele. A certain amount of hæmorrhage usually follows whilst the immediate lesion is associated with severe testicular pain. If the wound becomes infected, the tubules are likely to protrude, and a herma testis may result. All that is ordinarily required is to purify the parts and allow them to heal, sutures should not be inserted into the tunica albuginea if there is any doubt as to the wound being sterile. If the gland is totally disorganized castration must be undertaken.

Hæmatocele, or a localized collection of blood in the tunica vaginalis or cord, is a common result of injuries.

1. Hæmatocele of the Tunica Vaginalis arises from traumatism such as a sudden blow or severe strain, and occasionally follows the tapping of a hydrocele if a superficial vessel has been ruptured or punctured, or if the body of the testis has been wounded, it may, however, be due to general oozing from dilated capillaries in the serous membrane owing to the sudden relief of tension. It also occurs more or less spontaneously in connection with malignant disease. The history generally given is that the patient was seized with a sudden sickening pain in the testicle, which



FIG 834.—HÆMATOCELE OF LEFT TUNICA VAGINALIS

became quickly enlarged without any evidence of inflammation, blood was extravasated at the same time into the scrotum, the integument becoming discoloured in a few days (Fig 834). At first the swelling is smooth and fluctuating exactly resembling a hydrocele except in the absence of translucency, but owing to a deposit of fibrin on the walls, it soon becomes hard and firm closely simulating a solid tumour. In slight cases the blood is entirely absorbed, but when the effusion is considerable the coagulum is likely to persist. On laying open such a swelling the testicle is usually found in a healthy state, but the enlarged tunica is occupied by blood stained fluid surrounded by a mass of fibrous coagulum, part of which is deposited in laminae upon the walls and part remains as shaggy masses projecting into its lumen. In very chronic cases the walls of the tunica become thick and indurated, and may even undergo calcareous changes. Suppuration is sometimes met with as a result of auto-infection. The

Diagnosis of a hæmatocele in the earlier stages is easily made, but when it has solidified it can only be suspected by the history, and by the exclusion of other sources of enlargement, an exploratory incision or puncture is often necessary to settle the diagnosis. **Treatment.**—When the patient is seen soon after the injury, he must be kept at rest, the parts elevated, and evaporating lotions applied if the effusion is large, removal of a portion by aseptic tapping is helpful. In more chronic cases it may be necessary to lay the cavity open and remove its contents, but if the tunica has become thick and indurated, and the testis atrophied, castration may be advisable.

2 **Hæmatocele of the Cord** is rarely seen. A swelling of considerable size rapidly forms, extending along the cord from the inguinal region to the scrotum, but the testis remains free and uncomplicated. Such a condition may be mistaken for an omental hernia, but the tumour is more uniform in consistency, more rounded in outline, irreducible and without impulse, the history of an injury will assist the surgeon in making a correct diagnosis. **Treatment** in the early stages consists in the application of evaporating lotions, and later on, if the blood clot is not absorbed, the cavity may be laid open and the coagulum removed.

Rupture of the Vas Deferens has resulted from sudden strain, but is a very rare accident. It may affect the intra abdominal portion of the vas, and then gives rise to hæmorrhage from the urethra together with some amount of fever and hypogastric pain, leading possibly to atrophy of the organ. Rupture of the extra abdominal portion is followed by enlargement of the testis and perhaps scrotal hæmorrhage. This was associated in a case under our observation with hæmorrhage from the urethra on attempting coitus shortly after the accident and subsequently with severe pain and swelling of the testis produced by the same act, but atrophy did not follow. Attempts have been made to restore the continuity of a ruptured vas but without much success. If this fail, and the condition occasions inconvenience, it is best treated by castration.

Inflammatory Affections of the Testis may be chiefly confined at their onset either to the body of the organ or to the epididymis, in the former case the term **Orchitis** is applied to it, in the latter **Epididymitis**; as the case progresses both portions are involved in the process, either condition may be acute or chronic.

Acute Orchitis most frequently results from injury, but it is also met with as a primary affection in gouty and rheumatic individuals, sometimes arising spontaneously, or it may follow mumps, typhoid, or other eruptive fevers, and it is always to some extent associated with epididymitis. In mumps it may precede the parotid lesion, or may even occur without it.

The testicle becomes considerably enlarged, exceedingly painful, and tender to the touch. The shape of the organ is more or less globular (Fig 855 A), and the pain is of a peculiarly sickening character, extending upwards along the course of the cord towards the back and loins. The scrotal integuments become red and infiltrated, and, owing to the acuteness of the process, more or less adherent to the coverings of the

gland. A plastic or serous effusion into the tunica vaginalis is sometimes present giving rise to what is known as an acute hydrocele. Some constitutional disturbance accompanies the process, the temperature being elevated two or three degrees and vomiting and constipation are marked symptoms. It is unusual for suppuration to ensue, but an abscess occasionally forms and then after the pus has been let out a hernia testis may follow. Atrophy is a more common sequela especially in adults, being caused by constriction of the vessels and tubules owing to organization of the inflammatory exudate.

Acute Epididymitis is almost always due to the extension of an inflammatory process from the urethra, the usual cause being gonorrhoea; it occasionally follows the passage of instruments or the lodgment of a calculus, or it may be secondary to affections of the prostate if pyococci are present. It is ushered in by pain in the inguinal region and perhaps in the hypogastrium along the course of the vas deferens which soon extends to the scrotum. The testicle becomes enlarged but

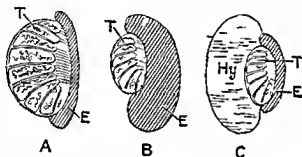


FIG. 833.—DIAGRAMMATIC REPRESENTATIONS OF (A) ORCHITIS, (B) EPIDIDYMITIS AND (C) HYDROCELE OF TUNICA VAGINALIS.
T Testis E epididymis Hy hydrocele

its shape is that of an elongated oval, somewhat flattened laterally. The epididymis is readily felt as a crescentic swelling partially overlapping the gland in all directions and in its concavity the rounded outline of the anterior wall of the testis can usually be distinguished (Fig. 833 B) or the tunica vaginalis distended with fluid. The scrotum is red, oedematous and adherent to the testis, and the cord is infiltrated, enlarged and tender. The same constitutional symptoms are met with as in orchitis. Suppuration is perhaps more common than after the latter affection, since the condition is usually due to a suppurating inflammation of the deeper parts of the urethra, but it is a rare complication. Atrophy of the testis is a not infrequent result in cases which are not efficiently treated, the plastic material exuded into the epididymis being organized into fibro-cicatricial tissue and constricting the spermatic vessels; an acute attack of double epididymitis may in this way render the individual sterile.

The Treatment of both these conditions in the acute stage consists in keeping the patient in bed, with the scrotum supported on a small

pillow The part is assiduously fomented, except when the case is seen very early, and then an icebag or Leiter's coil is employed. Pain, if severe, may be mitigated by a hot sitz bath or by morphia suppositories. As regards general treatment, the patient, after a preliminary dose of calomel, is kept on a fluid, unstimulating diet, and alkaline purgatives are administered with the addition of tincture of henbane or opium as a sedative, if the pulse is hard and the temperature high, *vinum antimonialis* in 10-minim doses is also beneficial. When the acute stage is passed the organ usually remains enlarged, and for a time somewhat tender. It is then best treated by strapping with lead plaster, or with the *emplastrum ammoniaci cum hydrargyro*. This must be continued until all signs of thickening and induration have disappeared.

Subacute or chronic forms of inflammation are also met with affecting the testis or epididymis, either as a consequence of the above, or resulting primarily from blows or strains. The characteristic enlargement is readily detected, associated with a certain amount of tenderness. A useful diagnostic point between the chronic epididymitis following gonorrhœa and that due to syphilis is that the former usually involves the *globus minor* and the latter is almost limited to the *globus major*. The condition is best treated by strapping and perhaps the administration of small doses of mercury and iodides may assist in the absorption of the inflammatory products. Chronic orchitis is very similar to the enlargement produced by syphilis, from which, indeed, it can only be distinguished by the Wassermann reaction being negative and the absence of a syphilitic history.

Tuberculous Disease of the Testis.—This affection is most commonly seen in young adults with a distinct tuberculous history, but it also occurs in otherwise healthy individuals. It may commence as a primary affection of the epididymis, or may be secondary to tuberculous disease elsewhere.

Pathological Anatomy.—The process originates in the connective tissue of the epididymis, and runs its usual course, at first consisting merely of a deposit of milary elements around the vessels, which by their coalescence and caseation lead to the formation of cheesy masses, and these at a later stage may emulsify and give rise to abscesses. It may be limited to any one part of the epididymis (most often the *globus major*), or may widely infiltrate its substance, causing a general enlargement (Fig. 856). In the latter case it early tends to spread, either into the body of the testis or along the *vas deferens*. The *corpus Highmorianum* becomes first involved by a similar deposit, and finally the intertubular connective tissue of the gland, this is always associated with overgrowth of the epithelium in the *tubuli seminiferi*, the cells after a time undergoing fatty degeneration, and perhaps to such an extent that, on microscopic section, the normal appearance of the organ has entirely disappeared. An abscess may form within it, and find its way to the surface by burrowing through the *tunica albuginea*, the visceral and parietal layers of the *tunica vaginalis* having previously become adherent. After the pus has escaped, a *hernia testis* is likely to develop. When

the process extends upwards along the cord the vas is mainly implicated becoming perceptibly thickened the other structures of the cord being but little affected. The disease spreads along the vas on the outside of the bladder to the vesiculae seminales and prostate and may even involve the base of the bladder the ureters and kidneys. Lastly general dissemination of tuberculous disease may occur and it is a curious fact that meningeal mischief is not very uncommonly associated with genital tuberculosis.

Clinical Signs—The disease is generally unilateral although the other testicle often becomes involved at a somewhat later date. Its onset may be abrupt or gradual in the former case the attack simulates an acute orchitis but at the end of a few weeks although the pain

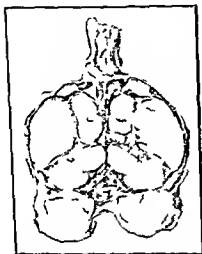


FIG. 836. TUBERCULOUS DISEASE OF TESTIS MAINLY INVOLVING THE EPIDIDYMIS AND CORD (KING'S COLLEGE HOSPITAL MUSEUM)

subsides the swelling persists being followed by the development of abscesses containing cheesy pus. In the more chronic cases one or more firm and indurated nodules which are free from tenderness are felt in the epididymis but more often the whole of this structure is found to be enlarged and thickened forming a painless crescentic swelling surrounding the posterior half of the body of the testis from which it is usually separated by a deep groove or sulcus. The epididymis is nodular and craggy to the feel and may be of unequal consistency areas of softening being interposed between portions which are distinctly hard. The vas is early thickened whilst the other structures of the cord are but little involved the thickening is more or less nodular and almost beaded in its consistency. The

body of the testis may be involved and enlarged the line of demarcation between it and the epididymis becoming indistinct. Testicular sensation remains as long as any normal glandular tissue exists and effusion into the tunica vaginalis is not usual. When suppuration occurs the pain increases especially if the abscess is in the substance of the organ. As it finds its way to the surface the skin becomes adherent to the testis and is red and congested. Gradually fluctuation manifests itself and the escape of the pus may be followed by a hernia testis. An abscess forming in connection with the epididymis is less painful and may attain considerable dimensions before it bursts it never gives rise to a hernia testis. Extension of the disease to the seminal vesicles causes no characteristic symptoms and is only detected on rectal examination when however the base of the bladder

and prostate are affected considerable dysuria and irritability of the bladder are induced

The differential diagnosis is discussed at p 1472

Treatment—If seen in the early stage, when the disease is limited it is possible that sanatorium treatment will suffice but if the lesion is at all extensive operative measures should be undertaken

When the whole epididymis is enlarged and solid and the body of the testis more or less normal *epididymectomy* will usually suffice In this procedure the tuberculous mass is freed from the body of the organ the spermatic vessels lying on the inner side are carefully guarded and the vas is dissected out and cleared as high as possible The presence of an abscess or sinus is no contra indication since it merely involves a somewhat freer removal of scrotal integument Should foci exist in the body of the testis they are likely to atrophy subsequently or they can be scraped out at a later date In this way the internal secretory function of the gland can be retained although its use as a generative organ is lost—a retention the more important owing to the likelihood of the other testis being subsequently invaded Even if the vas is thickened at the external abdominal ring or the vesiculae enlarged it need not deter the surgeon from operating since Nature will often deal effectively with what is left if accessible portions are removed

Castration is reserved for cases where the testis is disorganized and its value as a secreting gland totally destroyed Of course the cord is also removed after division as high up as possible Surgeons who believe that the epididymis infection is secondary to that of the seminal vesicle remove the epididymis vas and seminal vesicle through an inguinal incision the approach to the last named being extraperitoneal

Syphilitic Disease of the Testicle—The testicle may become affected either in the late secondary or in the tertiary stage most commonly it results from the acquired variety but occasionally is met with in the inherited

Secondary Syphilitic Epididymitis is unusual It occurs as a chronic enlargement of the epididymis associated perhaps with a hydrocele about six to twelve months after infection The case is very similar to a simple chronic epididymitis but the nodular thickening mainly involves the globus major and is usually symmetrical It quickly disappears on the commencement of treatment

Tertiary Syphilitic Orchitis is observed at a much later period of the disease even twenty or thirty years after infection It is not infrequently bilateral Pathologically, it resembles the majority of tertiary manifestations in consisting of a diffuse infiltration accompanied by overgrowth of the connective tissue If the process affects equally the whole organ the ordinary syphilitic sarcocoele or sclerosis of the testis results if it is more localized in its distribution the gummatous variety is said to be present (Fig 857) The former affection is much more common than the latter

In the tertiary syphilitic sarcocoele the body of the testis is primarily involved and becomes evenly enlarged and stony hard It is globular

in outline frequently accompanied by a hydrocele and the normal testicular sensation early disappears. The same process occasionally extends to the epididymis and cord. Suppuration is exceedingly rare. On section the characteristic appearance of a testicle has entirely vanished the tunica albuginea is much thickened and extending from it through the substance of the organ are bands of connective tissue representing the normal septa in bad cases the gland substance is almost completely destroyed.

In the gummatous variety a similar condition involves the greater part of the organ but in addition one or more gummatous foci are present. On section they appear as yellowish white masses fairly well defined and since the central portions are non vascular they undergo the usual degenerative changes becoming soft and diffuent. If the gumma comes to the surface the skin may give way and a deep syphilitic ulcer with a sloughy base like wet wash leather results. Hernia testis very rarely follows such an occurrence. The clinical features of the gummatous variety are at first similar to those of the former but after a time one portion of the organ becomes prominent and painful and as this increases in size the central parts become soft and fluctuating and finally yield giving exit to the characteristic gummy contents. Under suitable treatment the swelling in each of these varieties may disappear entirely, leaving the testicle either of normal size or atrophied but as in tuberculous disease its functional utility if not entirely destroyed is probably impaired considerably.



FIG. 85.—GUMMA OF TESTIS (COLLEGE OF SURGEONS MUSEUM)

For the differential diagnosis see p. 1472.

Treatment consists in the administration of iodide of potassium and mercury whilst the hydrocele may be tapped and the organ strapped or supported by a suspensory bandage. If a gummatous ulcer is produced it may be possible to excise the greater portion of the characteristic slough at its base but in all cases it should be dressed with lint or gauze steeped in *lotio nigra* or some other mercurial preparation. A strongly positive Wassermann reaction may justify treatment by salvarsan but when the affection is of old standing mercury must be employed.

Hernia Testis is the term applied to a protrusion of the substance of the gland more or less infiltrated with granulation tissue through an opening in the tunica albuginea and skin of the scrotum. It arises from various causes such as a septic penetrating wound of the testis acute suppurative orchitis or from a chronic abscess whether simple or tuberculous in nature. It is rarely produced by the breaking down of a gumma owing to the extensive infiltration of the organ with fibro-cicatricial tissue and necessarily it is never caused by suppuration in the epididymis. It is always preceded by a condition

of increased pressure within the tunica albuginea and consequently as soon as an aperture is formed in this membrane its natural elasticity allowing of its contraction forces a portion of its contents out of the opening this may even proceed to such an extent as to cause the whole of the substance of the gland to protrude the tunica albuginea being practically turned inside out. A mass resembling granulation tissue is then seen to project through an opening in the scrotum it is often somewhat pedunculated or mushroom like in shape possibly overhanging the margins of the skin. A considerable discharge of pus usually accompanies it. The condition must be distinguished from the fungating growth which occasionally results from malignant disease of the organ when the protrusion consists of tumour substance with no trace of testicular tissue.

The Treatment of hernia testis usually consists in extirpation of the organ especially when it is affected by tuberculous disease. In simple cases healing of the wound may be obtained by keeping the part aseptic and applying pressure by means of a pad of gauze. In other cases it may be possible to separate the protruding mass from the surrounding skin and after paring the edges of the wound to bring them together by sutures and thus bury the gland substance which however remains projecting from the opening in the tunica albuginea. Such proceedings are seldom very satisfactory.

Tumours of the Testicle—These are invariably malignant. Their classification is various and of little use actually from the surgical point of view there are two types the radio-sensitive (or seminoma) and the radio-resistant (or embryoma) both are types of teratoma.

A teratoma producing a testicular dermoid is very rare.

Seminoma—When the cut surface is inspected it presents a homogeneous appearance except for areas of degeneration which are common there is some tendency to lobulation. At microscopy the cells are large with protoplasm and resemble the spermatogenic cells.

Embryomas are somewhat slower in growth but are less amenable to treatment being radio-resistant. The cut surface of the growth varies in many cases there may be numerous small cysts (fibro-cystic disease) areas of cartilage and large cysts (Fig 858). At microscopy

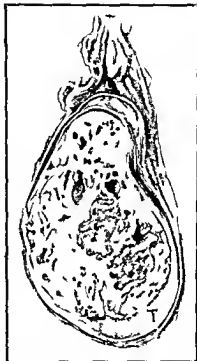


FIG 858—TERATOMA OF THE TESTICLE (EMBRYOMA TYPE)

There only remains a small portion of normal testis at the lower pole (1)

muscle may also be seen and gland structures, while the nature of the predominating cell may resemble a sarcoma or a carcinoma.

Clinical History—These tumours appear between twenty five and fifty years of age, a blow often attracting the patient's attention to the swelling, the part played by trauma as a cause is doubtful. Sometimes the testicle has gradually increased in size for two or three years and then rapid growth has ensued.

The glandular elements of the testicle are destroyed or compressed at the upper or lower poles of the swelling, and testicular sensation is usually absent. The swelling feels heavy to the examining hand, but diagnosis from a hæmatocele may be impossible without exploration.

Dissemination occurs by the blood stream with involvement of the lungs and by the lymphatics of the lumbar glands, the spermatic cord and the abdomen must always be examined for lymphatic enlargement. If untreated the overlying skin becomes adherent, ulceration and fungation soon following.

Treatment.—Orchidectomy with removal of the cord as far as the internal abdominal ring remains still the least unsatisfactory treatment, as the distressing possibility of fungation is removed.

Deep X ray therapy has some value in checking metastases in the lungs and abdominal glands, and thus treatment should be combined with orchidectomy.

Radium is useless with the embryoma type, and although good local results are reported from its use with seminoma the difficulty of satisfactorily irradiating the lymphatic area and lungs still remains.

Hydrocele.—Any collection of fluid other than pus or blood, in the neighbourhood of the testis or cord is termed a hydrocele. The fluid usually consists of serum but in some forms spermatozoa are also present and in rare cases it may consist of chyle or a similar milky fluid (chyloous hydrocele). Two chief varieties are described, according to whether the testis or the cord is involved.

1. In **Hydrocele of the Testis** the fluid is contained in the tunica vaginalis (vaginal hydrocele) or exists as a circumscribed swelling in its neighbourhood (encysted hydrocele).

1. A **Vaginal Hydrocele** is one in which there is an accumulation of fluid in the tunica vaginalis and the following varieties may be differentiated.

(a) **Acute Hydrocele** occurs in conjunction with acute inflammation of the testis or epididymis. The effusion of fluid is never abundant, and is often only made out on careful examination, at first it consists of plasma as in all acute inflammations of a serous membrane, and is therefore spontaneously coagulable. It may become chronic, or may disappear entirely perhaps leaving a few adhesions.

(b) A **Congenital Hydrocele** occurs in cases in which the funicular process is still patent. The general signs of a vaginal hydrocele, as described below are present but the fluid can be returned by pressure into the abdominal cavity. It is rarely seen in others than infants, and may be treated by the application of evaporating lotion to the scrotum whilst a light truss or woollen support is placed over the

inguinal canal, as for congenital hernia, if it persists it should be treated by operation

(c) An *Infantile Hydrocele* is due to non obliteration of the funicular process of peritoneum, except at its upper extremity. It presents the signs of an ordinary acquired hydrocele, the fluid, however, extending along the cord even into the inguinal canal. Its treatment is the same as for an acquired hydrocele

(d) A *Bilocular Hydrocele* is one in which there is an additional *loculus* within the abdominal cavity, communicating by a neck of variable size with the distended tunica vaginalis. It is due to a persistence of the intra abdominal portion of the funicular process between the peritoneum and internal abdominal ring. This becomes distended with fluid, and burrows downwards in front and by the side of the bladder towards the pelvis. A similar condition occurs in the female, arising in the upper part of the canal of Nuck

(e) *Acquired Vaginal Hydrocele* is the most common variety. **Causes.**—It may arise in middle-aged persons without any apparent cause, but is usually associated with chronic orchitis. A hydrocele almost always accompanies a tertiary syphilitic enlargement of the organ, but is uncommon in tuberculous or malignant disease. The tunica is usually thickened and hyperæmic, and that covering the testis may be pitted and scarred. Here and there thick plaques of fibrous material are visible, which may sometimes become calcified, or even osseous

Signs.—Vaginal hydrocele appears as a rounded pyriform swelling in the scrotum which extends for a variable distance along the cord. Its tension differs with the amount of fluid present, and with the thickness of its walls, it is usually elastic, and with obvious fluctuation. The cord is felt distinctly above the rounded upper part of the tumour, and the testis is generally situated posteriorly, although it projects forwards into the cavity, and is thus not readily detected. On holding a light close to the scrotum the swelling is seen to be translucent, and the position of the testicle can also be demonstrated. In old-standing cases when the walls have become much thickened, translucency will be lost. Occasionally, when inflammation has existed, adhesions may form between the testis and the anterior wall, and irregularity in the shape of the swelling is thereby induced, or the cavity may be divided into compartments by fibrous bands or septa

As a result of traumatism, subcutaneous rupture of a hydrocele has occurred, leading to increased swelling of the part, and perhaps œdema of scrotum and penis, the parts become bruised, but after a time the swelling diminishes, and perhaps a spontaneous cure follows

It is scarcely necessary to mention that there is no impulse on coughing, and that the tumour is dull on percussion. When the distension is very great, its weight causes a dragging pain, the penis becomes buried in the swelling, and eczema of the scrotum may result from the urine trickling over it. The *fluid* in the sac is yellowish or straw-coloured, its specific gravity varies from 1015 to 1025, it contains a large amount of albumen, especially fibrinogen. In old standing cases cholesterol may also be present

The Treatment of vaginal hydrocele is palliative or radical. Palliative treatment consists in tapping the cavity and removing the fluid, the patient being subsequently directed to wear a suspensory bandage, and, where inflammation of the testis exists, to apply cooling lotions. For chronic orchitis strapping of the testis may be required.

In order to tap a hydrocele, the tumour must be firmly grasped in the palm of the left hand, and the skin over its anterior wall purified and made tense. A spot at the antero-inferior margin is then selected, as free from vessels as possible, and a fine sterilized trocar and cannula inserted almost directly upwards, so as to pass in front of the body of the testis (Fig. 859). The site selected for tapping must, of course, vary with the position of the testicle, which should be previously demonstrated. The fluid having been withdrawn, the cannula is removed and the puncture covered with wool and collodion. The condition usually recurs after a longer or shorter period, and the operation may then be repeated. If a dirty instrument is employed inflammation, and even suppuration, may follow, if a blood vessel or the body of the testis is punctured a hæmatocele may result.

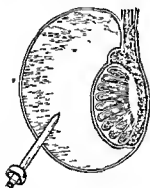


FIG. 859—METHOD OF TAPPING
A HYDROCELE

Radical treatment consists in injection of the cavity, or excision of the lining membrane. (i) Injection has been revived but is painful in the extreme, and the results are variable. Sodium morrhuate is the favourite reagent.

(ii) Open operation is now generally adopted, and is particularly recommended in large and chronic cases. The hydrocele is cut down on through an incision in the upper part of the scrotum, and the tunica vaginalis isolated from the superjacent structures. The cavity is opened, and the parietal portion of the tunica snipped away with scissors.

close to the testicle. A number of vessels will need to be ligatured, a drainage tube is inserted and the wound closed in the ordinary way. The results of this practice are most satisfactory.

When the sac is not too large and the tunica supple and uninfilted it often suffices to turn it inside out, and stitch its edges to the back of the epididymis.

In infants hydrocele is by no means uncommon, and may be, but is not always of the congenital type. The communication is sometimes very small so that reduction is impracticable, although on lying up the cavity slowly empties. It is desirable to make certain as to this point before undertaking treatment. If the sac communicates with the peritoneal cavity it may be treated as a hernia by truss pressure, or more satisfactorily by operation. If no communication exists, many cases get well spontaneously, but as a useful *placebo* the scrotum may be painted over frequently with a lotion of chloride of ammonium (grs. x ad 3i mixed with rectified spirit and water), in a few cases an

open operation (incision with drainage or partial removal of the sac) will be required

2 **Encysted Hydrocele of the testis** occurs in two main forms according to whether it arises in connection with the epididymis or the body of the testis

(a) *Encysted Hydrocele of the Epididymis* exists usually as a rounded globular swelling tense and elastic in consistency and translucent. It is situated above the body of the testis and close to the head of the epididymis (Fig 860). As a rule it does not attain a size greater than that of the body of the testis itself so that it may appear as if a double testicle is present the hydrocele is of course devoid of testicular sensation. Less frequently it may attain considerable dimensions even projecting below and around the testicle which though enveloped by it is quite distinct from it. The fluid contained within these cysts is usually milky and opalescent in appearance owing to an admixture of semen under the microscope spermatozoa either living or dead can be demonstrated on account of this it is sometimes termed a *spermatocele*. The specific gravity is lower than that of ordinary hydrocele fluid and there is but little albumen. The origin of these cysts has given rise to much discussion. They are of a very different nature to the ordinary vaginal hydrocele or even to the encysted hydrocele of the cord since the walls are not lined with endothelium but with cuboidal or columnar epithelium. They are probably due either to a dilatation of one or more of the vasa efferentia testis or more frequently to distension of some of the foetal relics always found near the head of the epididymis especially of those known as Kobelt's tubes (Fig 90 p 238). Smaller pedunculated cysts containing clear serum are sometimes met with in this region arising from a distension of the hydatid of Morgagni.



FIG 860—ENCYSTED HYDROCELE OF EPIDIDYMIS (COLLEGE OF SURGEONS MUSEUM)

Treatment is conducted along the same lines as for vaginal hydrocele viz by tapping as a palliative measure and injection or excision in order to establish a radical cure

(b) *Encysted Hydrocele of the Body of the Testis* is a condition rarely seen consisting of a small collection of serous fluid beneath the visceral portion of the tunica vaginalis. It is probably due to dilatation of lymphatic spaces and has no clinical significance

11 **Hydrocele of the Cord** occurs as already described in connection with the congenital and infantile varieties of vaginal hydrocele. If limited to the cord it exists in one of two forms the encysted or the diffuse

1 **Encysted Hydrocele of the Cord** arises from imperfect obliteration

of the funicular process of peritoneum the patent portion becoming distended with fluid and giving rise to a cavity lined with endothelium. It is usually detected as a rounded elastic swelling occupying the inguinal canal moving freely up and down within it. The upper border is sharply limited and in favourable cases translucency can be demonstrated. On fixing the testicle the cyst is no longer movable. The fluid contained within it is identical in nature with that in a vaginal hydrocele. In the female a similar condition arises from imperfect obliteration of the canal of Nuck giving rise to what is known as a *hydrocele of the round ligament*. Treatment consists in removal of the fluid by tapping or if a more radical proceeding is necessary by incision or excision.

2 **Diffuse Hydrocele of the Cord** is but rarely seen. It results from a diffuse œdema of its cellular tissue and presents on examination a fusiform or sausage-shaped tumour which extends along the cord for a variable distance.

The term **Chylous Hydrocele** is applied to a distension of the tunica vaginalis with chylous fluid recognized by being milky in appearance and under the microscope seen to consist of a fatty emulsion. Several modes of origin have been suggested but none are very satisfactory. In one case under our care a series of dilated lymphatics filled with a similar fluid extended upwards from the testicle to the inguinal canal.

Varicocele—A varicose condition of the pampiniform plexus is very commonly met with in young men but seldom in those of advanced age except when it has become chronic or is due to malignant disease of the kidney. It usually occurs in individuals with a lax and pendulous scrotum and is often associated with masturbation which induces abnormal vascularity of the testis. The fact that it sometimes develops in quite young boys suggests however that there is some congenital condition associated with it. It may also be caused by the pressure of a truss applied for the relief of a hernia. It is almost invariably on the left side and the reasons given for this are as follows: (a) The left testis usually hangs lower than the right and hence the spermatic veins are longer and exposed to greater blood pressure. (b) The left spermatic vein opens into the left renal vein at right angles and no valve is present at the orifice whilst that on the right side opens obliquely into the vena cava and is valved. (c) The presence of the sigmoid flexure on the left side of the body and its distension by accumulated feces as a result of constipation may lead to pressure on the abdominal portion of the left spermatic vein.

A varicocele is characterized by the presence of a soft irregular swelling in the scrotum which is somewhat pyramidal in shape the main mass being below and slightly overlapping the testis and the apex above. It consists of dilated and tortuous veins the outlines of which can often be seen through the skin (Fig 861). They impart a sensation to the finger which has been likened to a collection of living worms in a bag. There is a distinct impulse on coughing. On assuming the recumbent posture the swelling almost disappears owing to the vessels being emptied of their contained blood. If pressure is subsequently applied over the external abdominal ring and the patient allowed to stand the

tumour reappears filling from below upwards. A sensation of weight and pain usually accompanies a varicocele and severe neuralgia of the testis may be induced. It is a frequent source of seminal emissions and may result in testicular atrophy. Phlebitis is liable to follow an injury and may lead to a spontaneous cure if one of the dilated veins is ruptured severe hæmorrhage ensues causing a diffuse hæmatocele of the cord. In favourable cases the condition disappears spontaneously. For the diagnosis from omental hernia see p 1286.

The Treatment of slight cases of varicocele consists in supporting the testicle and scrotum by means of a well fitting suspensory bandage the patient is also instructed to bathe the parts with cold water night and morning and to take such measures as shall ensure a daily action of the bowels.



FIG 861 —LARGE VARICOCELE IN A PATIENT AGED 35 YEARS WHO HAD USED NO SUPPORT FOR MANY YEARS

Radical Treatment by excision of the veins is advisable in neuralgic cases where atrophy of the testis is threatening or in order to fit the patient for admission into any of the public services. It is however much less employed than formerly. The operation is conducted as follows. An incision $1\frac{1}{2}$ inches long is made in the direction of the cord with its centre a little below the external abdominal ring. The coverings of the cord are divided longitudinally so as to expose the spermatic veins at their upper end. Two main branches are usually found in this situation but occasionally there is only one. These are cleaned and carefully isolated from the other structures of the cord and a ligature is applied to them at the external abdominal ring. The vessels are now clamped with a pair of artery forceps below the ligature and divided between it and the forceps. The lower end grasped by the forceps is stripped downwards so as to free the pampiniform plexus from the other elements of the cord and the dissection can be carried nearly as far as the epididymis by drawing the testicle up into the

wound. The lower end of the veins is ligatured in one or two portions and divided. By this means the whole varicocele is removed. If the scrotum is pendulous and the testicle hangs low it is advisable to raise it by introducing sutures through the divided ends of the veins above and below and tying them together. The wound is closed without a drainage tube and dressed as usual. The patient is kept in the recumbent posture for a fortnight until organization has occurred in the divided ends of the veins and a firm cicatrix has formed. The venous return after the operation is maintained by the vein or veins running with the artery to the vas in the posterior portion of the cord. Occasionally if the removal of veins has been too complete a hydrocele develops subsequently owing to the passive congestion of the testis. It is usually unnecessary to remove any scrotal integument although it is often redundant but after the wound is soundly healed the dartos may be stimulated daily by brushing the scrotum with a clothes-brush. Injection treatment with small doses of reagents used for varicose veins is satisfactory after overcoming the difficulty of steadying these veins for the injection.

Neuralgia of the Testis is characterized by the organ becoming exquisitely tender and painful although apparently healthy. It usually occurs in young adults of nervous temperament or in middle-aged gouty men and may be associated with a varicocele. The pain is usually paroxysmal in character and very intractable. Treatment must be directed mainly to the general health but local sedatives *eg* belladonna and aconite may be applied. It is also advisable that a suspensory bandage should be worn.

Atrophy of the Testis results from several causes. (i) It may be due to a congenital arrest of development as met with in displacement or late descent. (ii) It is most frequently the consequence of inflammatory affections either of the body or epididymus owing to the cicatricial contraction caused thereby leading to compression of the vessels. It occasionally follows the orchitis of mumps especially in adults and is also due to syphilitic disease. (iii) It arises from impaired nutrition as after the division of the supplying arteries in operations for varicocele or hernia or from compression of the cord by closing the inguinal canal too firmly in the operation for the radical cure of hernia. It appears however that division of the spermatic vessels in an adult will not suffice to determine atrophy if the artery to the vas with its accompanying veins and nerves is preserved intact. A similar accident in a child will however suffice to prevent development of the organ. (iv) Chronic congestion of the testis as by a varicocele may induce atrophy. If unilateral it is of comparatively little importance but where both organs are affected sterility is sure to result and the patient if previously young and healthy is likely to become depressed in spirits and melancholic.

General Diagnosis of Scrotal Tumours.—When a patient presents himself for examination with a swelling in the scrotum the surgeon

has to decide whether it is a hernia, a hydrocele, a hæmatocele, a varicocele, or a solid enlargement of the testis, and, if the latter, of what nature. The first point to which attention is directed is the condition of the cord immediately below the external ring. If this is of normal size and consistency, hernia and diffuse hydrocele of the cord are thereby excluded, the existence of a rounded tense swelling, movable within the canal, but becoming fixed on holding the testis, indicates that an encysted hydrocele of the cord is probably present. When, however, the cord is more or less masked, further examination speedily determines whether a hernia or a diffuse hydrocele or hæmatocele of the cord exists, since the former is often reducible, has an impulse on coughing, and is rounded or nodular in outline, and the latter are sausage shaped, always irreducible, and semi fluctuating.

When the swelling is purely scrotal, inspection and manipulation will at once decide if it is a varicocele, by its characteristic feel, by its disappearance on assuming the recumbent posture, and filling again from below on standing up. If the swelling is rounded in outline, the next point to be determined is whether it is solid or fluid. If fluid, it is probably a hydrocele, or the early stage of a hæmatocele, the translucency of the former, and the sudden appearance and non-translucency of the latter, should suffice to demonstrate their nature. It is possible that the hydrocele is merely a secondary complication, and hence no final opinion should be given until it has been tapped, and the condition of the body of the testis investigated. If, however, a solid mass exists in the scrotum, it is either a hæmatocele in its later stages, or some form of enlargement of the testis, whether inflammatory, syphilitic, tuberculous, or neoplastic. A hæmatocele is possibly recognized by its history and by there being a fluid centre to the swelling, surrounded by solidified tissue. *Chronic orchitis* and *syphilitic* enlargement of the testis are so much alike as to render diagnosis always uncertain in the absence of a distinct syphilitic history, but if the swelling is extremely hard, with a smooth and regular outline, without testicular sensation, limited to the body of the testis, and accompanied by a hydrocele, it is probably syphilitic. *Tuberculous* disease, on the other hand, occurs more frequently in younger individuals than does the syphilitic variety, the epididymis is usually first attacked, becoming nodulated, the cord is early implicated, hydrocele is rare, suppuration is frequent, and testicular sensation remains till the body of the testis is disorganized. *Tumours* always impart a distinct sense of weight to the hand, quite different from that noticed in tuberculous or syphilitic disease, if a simple tumour is present, it is rounded, slow in growth, and the cord is unaffected. Malignant disease is characterized by rapid growth, more severe pain, and early implication of the structures of the cord and of the lumbar lymphatic glands. The enlargement of both testes is in favour of tubercle or syphilis rather than of malignant disease. A certain small number of cases will remain where, in spite of every care, the nature of the mass is still a matter of doubt, in such the diagnosis cannot be established without puncture or an exploratory incision.

Whilst weighing carefully the local conditions, we must not omit thoroughly to investigate and appreciate the general history and con-

dition of the patient, his age, appearance, previous habits and illnesses, etc., and his reaction to the Wassermann test. At the same time an examination of the internal organs should be made to ascertain, as far as possible, the existence or not of concurrent disease, *e.g.* tuberculous disease of the lungs, seminal vesicles or kidneys, or secondary malignant deposits.

Castration is required for many different conditions, which have been already described, *e.g.* for malposition, tuberculous disease, old-standing hæmatoceles, and simple or malignant tumours. The operation is conducted as follows. The pubes and perineum having been previously shaved and purified, the surgeon, standing on the same side of the patient as the organ to be removed, makes an incision down to the testis. If large and adherent to the scrotal tissues, the incision must necessarily involve the scrotum, but if the testis can be displaced upwards, it is wise to avoid the scrotal integuments. It should always extend upwards as far as the external abdominal ring, so as to enable the structures of the cord to be divided high up, and in cases of tuberculous or malignant disease, the inguinal canal must be laid open so as to expose the internal ring. The testis or tumour is enucleated from its surroundings, and the cord isolated and divided as high as possible, after transfixing and securely ligaturing it. Some surgeons prefer to separate the tissues of the cord, and to take them up individually, but this is a matter of little importance. The stump should not be allowed to slip back into the canal until all bleeding has completely stopped. Bleeding points in the scrotum are now secured by ligature, and these may be numerous, the wound is closed by sutures, a drainage-tube being inserted in the scrotum, and by choice coming to the surface at the upper end of the wound—that is, as far from the perineum as possible.

In the performance of double castration it is recommended to make two curved incisions from side to side, so as to include between them a crescentic portion of the scrotal integument, in order to reduce the subsequent redundancy of unnecessary tissue.

Affections of the Vesiculæ Seminales.

Acute Vesiculitis is not often met with, but sometimes arises, in association with prostatitis as a complication of gonorrhœa. It is characterized by deep-seated pain in the perineum, together with irritability of the neck of the bladder and increased frequency of micturition. Defæcation becomes painful and on examination of the rectum the vesiculæ can be felt enlarged and tender. If suppuration ensues an abscess forms, which usually bursts into the rectum, but sometimes into the bladder or peritoneal cavity. As a rule, the condition disappears *pari passu* with the gonorrhœa, but when suppuration has supervened, it is advisable to open the abscess by a deep incision through the perineum, guided by a finger in the rectum.

Subacute or Chronic Vesiculitis is not uncommon, the latter condition being often associated with prostatitis, and one of the most frequent

causes of gleet. Seminal emissions and priapism may be caused by it, and the enlarged organ can be felt through the rectum. A good deal of pain, often referred to the back, is experienced. The treatment is the same as for chronic prostatitis, although it is somewhat doubtful whether diathermy is of much use in these cases. Possibly vasotomy and the injection of silver salts through the open vas will be of some help.

Tuberculous Disease attacks the vesiculæ seminales as a result of extension from the testis along the vas, being almost always associated with similar disease of the prostate and base of the bladder. The organs can be felt enlarged, and if suppuration occurs, the abscess may burst into the rectum or bladder, or possibly into both, a recto-vesical fistula being thereby developed. The vesiculæ can be reached without much difficulty through a curved incision in the perineum with its convexity forwards, displacing the rectum backwards and the bladder and prostate forwards. When exposed, complete excision is sometimes possible, or an opening is made into them, and the cheesy contents scooped out.

Affections of the Scrotum.

Injuries of the Scrotum.—Contusions and blows give rise to ecchymosis, which may be so extensive as to warrant the term *hematoma scroti* which has been applied to it.

Incised wounds may affect the skin and subcutaneous tissues, or may lay open the tunica vaginalis, with or without protrusion of the testicle. All that is needed in such cases is to render the wound aseptic, and to deal with it on general principles. Considerable destruction of scrotal tissue may be repaired by transplanting flaps from the inguinal region, or by grafting according to Thiersch's method.

Cellulitis of the Scrotum most commonly results from extravasation of urine, for which see p. 1449. It may occasionally arise from other causes, and leads to great constitutional disturbance, usually of an asthenic type, and often to considerable sloughing, the testes may be exposed when the sloughs come away, or may even be involved in the same process. As a general rule, repair is very active in the scrotum.

Oedema of the Scrotum is usually due to dropsy, being often associated with general anasarca and ascites. It may attain considerable dimensions. *Acute inflammatory oedema* of the scrotum is a term sometimes applied to erysipelas affecting this region, on account of the absence of the vivid red colour usually caused by that affection. Considerable oedema is always present, and gangrene of the skin may result. As soon as the gangrene becomes limited it should be excised, and the margins of the wound brought together by sutures, or allowed to heal by granulation.

Scrotal Fistulæ are usually due to the bursting of abscesses in connection with the urethra (p. 1448).

Sinuses of the Scrotum are often found in connection with tuberculous or syphilitic disease of the testicle.

Eczema of the Scrotum is a troublesome affection, giving rise to great pruritus and irritation. It results from the presence of pediculi, but

the more chronic forms occur amongst workers in tar and paraffin, and also in chimney sweeps, being due to the constant irritation of the corrugated scrotal integument by dirty clothes. It is associated with the presence of warty outgrowths and not unfrequently runs on to epithelioma, originating the condition known as *chimney sweeps* or *paraffin cancer*. The usual characteristics of such a new growth are present, and in some of the deeper cells particles of soot have been demonstrated. The inguinal glands are usually involved, but not till late and the progress of the case is slow. The only treatment which can be adopted is complete removal, together with the inguinal glands.

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CHAPTER XLVII

AMPUTATIONS

General Remarks

THE surgeon who is about to remove a limb must always keep in mind that the operation to be performed has two ends in view (1) To remove the offending member with as little shock and sacrifice as possible and (2) to provide a stump suitable for the requirements of the maker of artificial limbs. Too often in the past this latter desideratum has been forgotten but the huge experience recently acquired in connection with this subject has emphasized its need.

In a review of 1 000 cases of primary amputations of the leg recently dealt with in the British Isles some interesting figures are shown.

1 Approximately 90 per cent of these amputations fall into two classes: 1 *e* above the knee or below the knee. The remaining 10 per cent are disarticulation at the hip. Stokes, Gritti's, Stephen Smith's, disarticulation at the knee, Syme's, Chopart's, etc. From this it would appear that it is fairly common practice throughout the British Isles to amputate either above or below the knee and that the other undesirable types of operation are not often performed.

2 Some 12 per cent of the above knee amputations are too long: 1 *e* over 10 inches and 16½ per cent of the below knee amputations are too long: 1 *e* over 9 inches of stump.

3 The causes of the amputations were

(a) Disease 35 per cent

(b) Accidents 65 per cent and it is quite probable that the incidence of road accidents will gradually increase.

4 At the present time there are about 4 000 amputations performed in the British Isles every year.

I The Actual Removal of a limb may be required as an immediate urgent necessity in order to save life from shock, hæmorrhage or infection—or it may be undertaken more deliberately with a view to remove some more chronic condition. The patient may be in a good condition of health so that the surgeon need not hurry over the work or he may be so seriously ill that every extra minute taken by the operation is dangerous. It is obvious therefore that methods must vary with the local and general condition of the patient.

A When the limb is infiltrated with inflammatory products the result of a grave infection and still more if gas gangrene is threatening or present and the patient's general condition is poor the most rapid amputation possible must be undertaken. Moreover it must permit

of suitable tissue-drainage and be kept as low as possible, since a re-amputation may be required later on

For this purpose short muscular flaps are cut from the front and back of the limb the deeper parts are divided by a circular sweep of

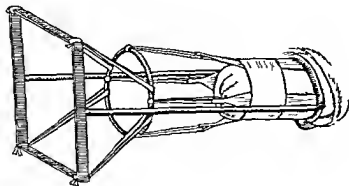


FIG 862—METHOD OF APPLYING EXTENSION TO AMPUTATION STUMP

the knife and the division of the bone by the saw permits the removal of the limb. Bleeding points are secured, and then the flaps are either loosely sutured together over a pad of gauze soaked in dichloramine-T or flavine, or may be stitched back out of the way for a time, so as to secure efficient tissue-drainage. To prevent undue retraction of the soft parts, an extension appliance similar to that represented at Fig 862 may be employed. The guillotine operation so often used during the late war is most undesirable, and should never be undertaken.



FIG 863—CIRCULAR AMPUTATION THROUGH THE THIGH

B When the amputation is undertaken deliberately for conditions which are not urgent, more consideration may be taken of the requirements of the artificial limb maker, and more stereotyped methods may be employed. All amputations are in the main merely modifications of three cardinal operations—the circular, the racquet shaped, and the flap.

1 The Circular Amputation (Fig 863) is now but little used, in it the skin and subcutaneous tissues are divided around the whole circumference of the limb by a circular sweep of the knife. These are then retracted or dissected back like a cuff, and

the superficial muscles divided in a similar manner. The soft parts are again further retracted and the deeper muscles divided, allowing the

bone to be cleared and sawn through at a still higher level. The end of the bone is thus placed at the apex of a conical hollow (Fig 864) and can be completely covered over. The vessels moreover are divided transversely. The stump is not very shapely and after a time owing to the shrinking of the soft parts the cicatrix is likely to become attached to the bone. The arm is almost the only situation in which a pure circular operation is ever undertaken at the present day.

2 In the Racquet shaped Method an oval incision is made around the limb with one end pointed and if necessary prolonged upwards to form as it were the handle of the racquet. This method is useful for removing fingers and toes and is also employed at the hip and shoulder joints.

A somewhat similar operation is known as the Elliptical or Oval Method. In it an oval incision is made around the limb the lower or distal portion is then dissected up so as to enable the amputation



FIG 864 — SECTION OF PARTS AFTER CIRCULAR AMPUTATION

A Skin and subcutaneous fat B muscles C bone



FIG 865 — AMPUTATION OF THE THIGH BY LISTER'S FLAP AND CIRCULAR METHOD

A indicates the anterior flap B the posterior which is half the length of the anterior C the line of division of the muscles which is performed by circular sweeps of the knife



FIG 866 — LATERAL VIEW OF THE SAME OPERATION WITH THE SKIN FLAPS DISSECTED BACK

or disarticulation to be completed at a level a little below the proximal end. The free convex border of the flap is then turned over and fitted into the concavity of the wound.

3 The Flap Method is that chiefly made use of at the present day

in amputating through the shafts of the long bones. It was formerly performed by *transaxion* in order to save time but the bulk of muscles included in the flaps and the fact that the vessels and nerves are often sliced longitudinally render this an undesirable proceeding. Hence it has been discarded and the flaps are now usually marked out superficially and then raised by *disssection*. As a rule they consist merely of skin, subcutaneous tissue and deep fascia, a little muscle being perhaps included towards the base.

The best method of amputating in muscular parts such as the thigh is that known as the **Modified Flap and Circular** (Figs. 865 and 866) which was originally suggested by Lord Lister. In this two rectangular flaps with the corners rounded off are raised on opposite sides of the

limb, the length of the anterior being two-thirds of the diameter of the limb at the point at which it is proposed to divide the bone and the posterior flap half of the length of the anterior. These consisting merely of skin and subcutaneous tissues are dissected up, the muscles are then divided circularly being retracted for another half-diameter. The advantages of the flap and circular methods are thus combined (Fig. 865).

11 Since the end results of an amputation depend so greatly on the appliance that is afterwards supplied it is necessary for the surgeon to have some knowledge of artificial limbs. A modern artificial limb is constructed with a view to giving maximum strength and comfort with minimum weight and it has been found that a light metal alloy such as duralumin gives these requirements.

In practice it is found that 90 per cent. of lower limb amputation cases can be fitted with one of two types of limb, the one known as the above knee type and the other as the below knee type.

(a) **The Above-Knee Type**—Thighs or shins are pressed in one piece from thin sheet metal and the old fashioned bulky wooden sockets and lacing leather corsets are replaced by metal sockets, enamel finished and carefully perforated to allow ventilation. Knee-joint mechanisms are built internally to give a smooth appearance and are designed to control the swinging of the limb and produce a natural action.

The socket is shaped to take the greater part of the patient's weight on the tuberosity of the ischium and a taper muscular stump is of great value in sharing the distribution of weight.

The limb is supported by a special form of pelvic band which allows free movement of the stump in all directions. The old fashioned chest and shoulder harness which used to serve the double purpose of swinging the limb and holding it in place is no longer necessary.



FIG. 867 — AMPUTATION THROUGH THE THIGH BY UNEQUAL FLAPS

(b) **The Below Knee Type**—The shin is pressed in one piece from thin sheet metal and supports a leather socket which is moulded from a carefully rectified plaster cast of the stump. The ankle mechanism is self contained and the working clearance between foot and shin is imperceptible. Ball bearing side steel joints attached to a soft thigh corset give support and freedom from lateral strain to the knee joint.

From the prosthetic point of view the following are important

1 **The Site of the Amputation**—The stump should be long enough to give sufficient leverage yet short enough to allow room for an internal mechanical joint. The level of the amputation must be decided partly by the character and extent of the disease partly by the requirements of the limb-maker. Whilst it is always requisite that the whole disease should be removed it is also desirable to effect this with as little sacrifice as possible.

2 **A Sufficient Covering** is necessary in order to protect the end of the bone from injurious pressure. If the skin were not contractile and if the muscles did not retract it would suffice to provide two flaps each equal to half the diameter of the limb at the point of section of the bone but owing to the contractility and retraction of living tissues it is essential to allow at least a diameter and a half and sometimes two diameters. In non muscular parts the former may suffice but in fleshy parts especially when amputating low down in the thigh where the range of muscular contraction is much greater the latter. It is usually a matter of some significance whence the flaps are derived thus a single flap e.g. a long anterior or posterior is not to be recommended owing to the difficulty of maintaining its nutrition. Equal flaps antero-posterior or lateral are used in parts like the arm where the end of the stump will not be exposed to pressure generally however one flap is cut longer than the other.

3 The soft parts covering the stump must be of a healthy character soft supple and movable over the end of the bone the medullary canal of which becomes closed by a layer of compact bony tissue. A comfortable sufficiency is required but no excess as pain and irritation are caused thereby and increased difficulty is experienced in wearing an artificial limb. The end of the bone should if possible be covered by a suitable muscle pad which serves to protect it from pressure and over this the skin should move freely. It is however possible to wear an artificial limb over an adherent scar but it is less satisfactory and liable to develop later trouble.

4 The position and character of the cicatrix are important. In the leg it should not be terminal but lie to one or other side preferably behind in the arm a terminal scar is desirable. The scar itself should be as nearly linear as possible although this may be impracticable at any rate it must be soundly healed before applying an artificial limb not adherent to the bone with no tendency to eczema or ulceration and not unduly sensitive.

5 The stump must be free from tenderness and able to stand a certain amount of pressure. The nerves divided during the operation follow the rules natural to these structures and develop bulbous ends (115, 156 p. 393). If these bulbs become adherent to the end of the

bone or to the scar, they are pulled on by every movement of the stump or are exposed to pressure, and hence become a source of constant pain and disability. The greatest care must be taken in amputations to divide all the main nerves high up.

6 The portion of the limb that remains must be carefully conserved. There is often a tendency for muscles to take advantage of the loss of the long lever provided by the limb in order to drag the short remaining portion into a bad position, *eg* the upper parts of the arm and leg are very liable to be abducted, thus must be guarded against most carefully, so as to conserve adduction.

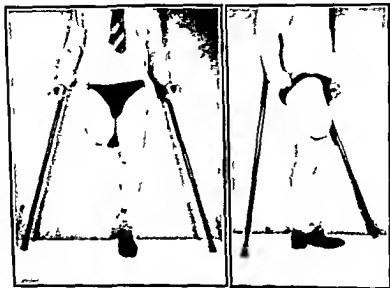


FIG 868—PRIMARY CASE OF AMPUTATION ABOVE THE KNEE OF IDEAL LENGTH

The stump is very oedematous and almost the same size as the natural leg. Binding and exercising as described in the text, are necessary to prepare the stump for an artificial limb.

(By courtesy of Mr E. R. Desoutter)

The joint above the site of amputation must also be kept movable and not allowed to become stiff, it is therefore wise to apply a splint for a time to keep the muscles quiet and prevent undesirable contraction. In a forearm amputation the elbow is likely to become flexed and extension may be lost, unless the limb is kept for a time on a splint in an extended position, and the elbow moved regularly. The same rule applies to an amputation below the knee.

7 After the wound is healed the necessity for proper care of the stump can scarcely be over-emphasized. In the early stages after amputation the greatest trouble the patient experiences with the fit of the artificial limb is caused by shrinkage and atrophy of the stump.

and it is therefore highly desirable to prepare the stump for the limb as soon as possible (see Fig 868) The time necessary for consolidation varies with each individual for example an elderly patient suffering from arterial disease will be weak, and it is advisable to wait four to six months before attempting to wear a limb on the other hand a youth who has lost his leg as a result of an accident will be strong physically, and with proper treatment will probably be ready for limb fitting about six to eight weeks after amputation For a patient to be left, as so often happens eight months or so after opera-



FIG 869

FIG 869 —PLASTIC STUMP EXERCISER WHICH SHOULD BE USED PROGRESSIVELY IMMEDIATELY THE STUMP IS HEALED

The movements should be extension flexion and adduction



FIG 870

FIG 870 —SHOWING THE CORRECT METHOD OF BINDING THE STUMP FROM ABOVE DOWNWARDS ALL THE FLESH COMPRESSED AT THE BOTTOM OF THE STUMP Comparison with Fig 869 will show how much the stump is compressed by binding

(By courtesy of Mr E R Desoutter)

tion with no treatment whatever is both prejudicial to the end results and a waste of time All cases should be exercised as soon as the wound is healed, the patient should perform active movements against resistance two or three times a day for twenty minutes, a convenient stump exerciser can be procured in which the resistance is provided by elastics, the strength of which can be increased progressively (see Fig 869) In this way the muscles are developed and superfluous flesh reduced (It is possible to reduce a thigh stump 2 to 3 inches in circumference in four to six weeks by this means) At the same

time mobility is retained and flexion and abduction are counteracted. A crepe or rubber bandage will help to ensure even shrinkage. It should be applied firmly *from above downwards* to prevent the formation of a roll of flesh at the top of the stump, and should be worn continuously (see Fig. 870).

The use of a temporary pylon is a habit left from the late war when patients could not be fitted with limbs quickly enough, and is to be condemned. The small balancing point upsets the patient's equilibrium and because there is no knee joint the patient is forced to swing the pylon out to the side at every step, a habit it is almost impossible to cure when a permanent leg is fitted. A pylon should only be used when there is no prospect of fitting a permanent limb, or if locomotion is essential to the patient during the first few weeks. These cases should be fitted by an experienced limb maker. The plaster pylon so often seen is most undesirable, usually constructed on wrong principles and ill fitting, it tends to develop a roll of flesh at the top of the stump, which gives much trouble to the limb-maker when a permanent limb is fitted.

Pathological Changes in Stumps—*Infection of the stump* should not occur in amputations performed for disease or with unbroken skin, but in casualty work (civilian or military) where damaged or infected limbs have to be removed, infection cannot always be avoided. It may be limited to a localized suppuration, which merely requires the removal of a few stitches to effect drainage, and the packing of the cavity with gauze soaked in some suitable application, *e.g.* flavine, 1 in 1000, or dichloramine-T in oil, as soon as infection has ceased and healthy reaction is secured, the flaps may be drawn together by strapping or closed by secondary suture. In the more severe cases it is necessary to open up the stump freely and at an early date, and not merely to introduce a drainage-tube through a small hole, thereby permitting the trouble to gather headway under the closed wound, when the infection has come to an end, secondary suture is available unless necrosis has occurred.

Necrosis of the end of the bone is not an unfrequent result of infection especially if the periosteum has not been retracted before dividing the bone and subsequently brought together over the medullary canal to protect it. Rough handling during the later stages of the operation will predispose to its development, but practically it never appears apart from infection. A small annular sequestrum is usually all that separates, but should the inflammation spread up the medullary cavity (acute traumatic osteomyelitis) a more extensive destruction of bone tissue follows.

In the milder cases there is but little inflammatory reaction or pain, and all that appears is a sinus that will not heal. These cases should always be X rayed, and sequestra will often be found. Operation for their removal should be undertaken at the earliest possible moment, they usually become loose in from two to three months. Prolonged retention means increasing sclerosis of tissues and may necessitate a re amputation.

Sloughing of the ends of the flaps occurs in debilitated individuals,

especially if thin skin flaps have been employed, or if their nutrition has been impaired by trauma, or if unhealthy tissue has been incorporated in their substance by amputating too close to the seat of disease or injury. The process is usually limited in extent, and rarely calls for treatment other than keeping the part dry and aseptic, the slough being then slowly absorbed. If infection is present, the consequences may be more serious, even necessitating re-amputation at a higher level.

A *conical stump* results either from the flaps being cut too short, or from the parts shrinking as a result of suppuration, or in young people from continued growth of the upper epiphyseal cartilage of the divided bone. In bad cases the bone may even project through the integument, and necrosis, re-amputation is the only treatment.

A *painful stump* is usually due to the adhesion of a bulbous nerve-end to the cicatrix or bone, so that it is dragged upon at each movement of the limb. The pain is of a severe neuralgic nature, and is treated by excising the bulb, or by re-amputation. In other cases it is due to the projection of a *spur* from the divided end of the bone (Fig. 871), which presses on and irritates the tissues of the stump. These spurs are usually due to the want of a periosteal cuff to cover the divided end of the bone, or to imperfect protection of the soft tissues whilst dividing the bone with the saw, living bone cells are thus rubbed into the muscles, and ossification ensues.

Still another cause of pain in a stump is the persistence of inflammatory trouble in the bone which may be present as a subacute or chronic osteitis or osteomyelitis. The bone is enlarged and tender, necrosis may follow at a later date, and suitable treatment will be required, perhaps even a re-amputation.

It is obvious, therefore, that in all cases of painful stump a radiograph is essential, if a correct diagnosis of the cause is to be made.

A *spasmodic stump* sometimes occurs, being due either to irritation of the enlarged nerve-ends, or to some central cause. In the former instance, excision of the bulbs or re-amputation will cure the case, in the latter, the trouble will persist in spite of treatment, affecting fresh groups of muscles after re-amputation.

The scar itself may sometimes give trouble after healing has occurred. It may become dragged into a deep pucker in which eczema occurs. Ulceration may occur from local irritation or from general debility. In these circumstances, if suitable local or general treatment is unavailing, excision of the scar is required, especially if it is adherent to the end of the bone, or re-amputation.



FIG. 871.—WELL-MARKED SPUR DEVELOPED AT THE LOWER END OF A DIVIDED FEMUR, NECESSITATING RE-AMPUTATION FOR PAIN.

General Technique of an Amputation.

A number of the more important elements in the operation have been already alluded to, but it is desirable to insist on them once again.

The greatest care must be taken to maintain *asepsis* whenever possible, since muscular and fascial planes are freely exposed, and possibly the medullary cavity of the bone opened, the dangers of infection under such circumstances are obvious. *Hæmorrhage* is prevented by previous *exsanguination* of the limb by elevating it for two or three minutes, as first suggested by Lord Lister, and then applying an elastic tourniquet. In the leg a piece of flat rubber tubing may be employed. In the arm however, paralytic symptoms, usually involving the musculo-spiral nerve have followed the use of such appliances especially when made of solid rubber, a flat elastic bandage, carried several times around the limb and secured by a knot or with a safety-pin is all that is needed. The tourniquet must, of course, be first sterilized. It is also advisable to protect the skin over which it is placed by a few layers of sterile gauze. After the limb has been removed, the main vessels are at once ligatured both artery and vein being separately tied. It is well to isolate and draw them down for a little distance, so as to make sure that they have not been buttonholed. Any other vessels which can be seen are tied before the tourniquet is removed. An assistant should for a time be ready to control the main trunk after releasing it from the tourniquet. In some cases it may be impracticable or undesirable to apply a tourniquet, and then the main vessels may be temporarily controlled by digital compression at some suitable spot whilst the amputation is completed. All bleeding-points are rapidly secured by pressure forceps and subsequently tied, and the main trunks isolated and clamped or ligatured before division.

Attention has already been drawn to the necessity of not tapering the flaps but of cutting them square, the corners alone being rounded. In dissecting them up, the deep fascia should be included with the flap, and the blade of the knife always turned towards the part which is to be removed so that the under surface of the flap, and with it the nutrient vessels shall not be scored. Whilst dividing the muscles, the flaps must be carefully guarded by the hands of assistants. Before dividing the bone it is recommended that the periosteum should be retracted for some distance so as more efficiently to provide for its nutrition and to cover the divided end subsequently, this plan should certainly be adopted for the humerus and femur. During the division of the bone the soft parts should be protected by a cloth so as to prevent bone dust being rubbed into the muscles and giving rise to myositis ossificans at a later date. Any irregular bony spicules left after sawing should be trimmed off with cutting pliers and the periosteum is replaced and secured by deep sutures. Attention must next be directed to the main nerves and to any tendons which lie exposed in the wound, all such structures being cut short, the nerves as high as possible. The end of the bone should be covered by stitching the muscles together over it, and the little extra time expended in the introduction of these buried stitches will be well repaid in the improved shapeliness of the

stump The skin wound is usually closed by a continuous suture, and provision made for drainage from one of the angles of the incision. The dressing is applied in such a way as to draw the flaps down over the end of the bone, and a splint is generally necessary in order to control the upper ends of the divided muscles and to keep them from spasmodic contractions.

The chief complications likely to arise in the subsequent course of the case are shock, reactionary hæmorrhage, and those which result from infection, these conditions and their treatment have been described elsewhere.

Re-amputations are not unfrequently required, especially in military work, where the primary operation has often been undertaken merely to save life, and sometimes with but little thought of subsequent prosthesis. Large open wounds result which take months to heal, and even then the stump is unsatisfactory and cannot bear pressure, so that a re-amputation as soon as it is safe is most desirable, and will save both time and pain. In other cases the wound is healed, but for various causes indicated above the stump is unsatisfactory, and an artificial limb cannot be worn: a secondary operation is therefore necessary.

In an *aseptic case* the operation is very simple. If the scar is healthy, it may be opened up if the scar is adherent to the end of the bone, incisions are made to encircle it, and are prolonged on either side. These are gradually deepened by carrying the knife inwards to the bone from which the loosened soft parts are retracted. When the bone has been cleared at the desired level, it is divided for choice by a Gigli saw. Hæmostasis is effected, and the skin separated from the deeper tissues by undercutting all round, the muscles are drawn together over the end of the bone, and the skin margins united by sutures. It is essential that no tension be present. Naturally, modifications of the incisions have to be devised to meet any special peculiarities of the stump.

In cases *where the primary wound is unhealed*, a more difficult problem presents itself, but good results and primary healing are obtainable if certain precautions are adopted. In the first place, acute sepsis must be dealt with in the usual way, and no attempt made to re-amputate until the condition has quieted down.

In the operation the skin above the granulating area is most thoroughly cleansed, and the wound itself scrubbed with gauze swabs to provide mechanical disinfection, and then any antiseptic that the surgeon favours can be applied. The operation is conducted in the usual way, taking special care to provide a sufficiency of skin covering which is dissected up from the muscles. It is most desirable in these cases to have a periosteal cuff which can subsequently protect the medullary canal.

Bleeding vessels having been secured and nerves shortened, preparation is made to close the wound. Various plans are recommended, and herein lies the great difficulty of gaining a successful result. (1) Some surgeons draw the flaps lightly together over a gauze pack soaked in a solution of flavine, and do not attempt closure for a few days, absence of inflammatory reaction proves that complete closure

may be safely attempted (2) Others prefer 'Bipp' treatment. The wound is washed with absolute alcohol and dried, and then a sufficiency of 'Bipp' is rubbed into all the tissues, and closure is effected by deep and superficial sutures. (3) Other surgeons consider that it is useless to apply antiseptics, and pin their faith on deep sutures applied so as to coapt the parts without tension, thereby preventing the collection of blood in dead spaces between the flaps. The superficial stitches must also be free from tension. It is wise, however, to provide for drainage. Satisfactory healing usually follows though it often does not occur without suppuration.

Special Amputations: Upper Extremity.

The end results are not so satisfactory on the whole as those obtained with lower extremity amputations, for it is impossible to replace the intricate movements of the fingers by any mechanical device.

Amputation of the Fingers is frequently required after machine accidents and similar injuries, or in necrosis following a whitlow. In these cases it is often impossible to follow any regular routine, the flaps being obtained from any portion of sound tissue present. The following, however, are the chief plans adopted.

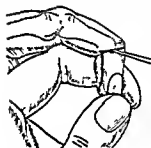


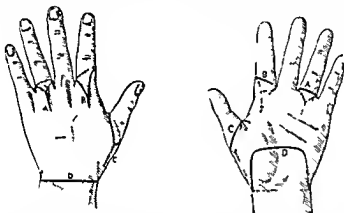
FIG. 872.—INCISIONS FOR AMPUTATION OF TERMINAL PHALANX OF FINGER.

Amputation of the Terminal Phalanx is usually conducted by opening the joint on the dorsal aspect and cutting a palmar flap from the pulp of the finger (Fig. 872).

No useful result follows amputation through the first interphalangeal articulation since the portion left is practically fixed and useless, no tendons being inserted to govern it. An operation which is sometimes advantageous consists in amputating through the middle of the second phalanx, so as to leave the insertion of the flexor sublimis tendon; the flaps for such an operation are derived from any part of the finger, and the bone is divided by cutting pliers.

Removal of a finger at the Metacarpo-phalangeal Joint is an operation frequently necessary. It is best conducted by means of a racquet-shaped incision (Fig. 873 A) which starts over the knuckle, extends between it and the next finger, curves round to the palmar aspect so as to be placed a little below the crease in the skin at the root of the finger (Fig. 874 A), and returns in the same way to the back of the knuckle. This incision can be made with one sweep of the knife, but there is no real advantage in such a procedure. The articulation is then opened from behind, the structures on either side are successively divided, making them tense by rotation of the finger, and the flexor tendons finally cut across. Bleeding points (usually one on each side) are secured, and the wound closed.

The question of removing the head of the metacarpal bone is one which must be decided by the occupation of the patient if he is a working man, or needs strength of hand, it should be left, as its removal always causes weakness. In ladies and those where smallness and elegance of the hand are required rather than strength, it can be taken away by slightly prolonging the incision upwards, clearing the bone on either side, and applying cutting pliers. The gap between the adjoining fingers can in this way be almost obliterated. It is especially advisable to do this in the case of the index finger, since the head of the second metacarpal bone forms an unsightly projection and is very exposed to injury. For this finger, Larabœuf's method (Figs 873, B and 874, B) is often used. When the finger is removed for a bad whitlow it is often wise merely to disarticulate at the metacarpo-



FIGS 873 AND 874.—DORSAL AND PALMAR VIEWS OF HAND WITH INCISIONS FOR VARIOUS AMPUTATIONS

- A Incision for amputation of finger by racquet method. B Farabœuf's method of amputation as applied for index finger. C racquet shaped incision for disarticulation of thumb at carpo metacarpal joint. D amputation through the wrist by a long palmar flap. In all of these the continuous black lines indicate the portions of the incisions visible from the dorsal or palmar aspects respectively the interrupted lines the portions that are hidden.

phalangeal joint and allow the septic trouble to quiet down and the wound to heal by granulation. At a later date a neat re-amputation, including if need be, the removal of the head of the metacarpal may be successfully undertaken.

Occasionally the four fingers and their attached metacarpal bones have to be removed *en bloc*. Short equal flaps may then be cut from the front and back of the hand and the disarticulation effected. The stump that remains although consisting of merely the carpus and thumb, is very serviceable.

Amputation of the Thumb should never be undertaken unless absolutely necessary, since its removal seriously impairs the functional utility of the hand as large a portion must be saved as practicable so as to assist the patient in grasping. The phalanges may be removed

by any method which enables the bone to be covered with the least possible sacrifice

When it is also necessary to take away the metacarpal bone one of the two following plans should be adopted

1 *The racquet method* (Figs. 873 C and 874 C) In this an incision commences in the intertendinous hollow known as the *labatiere* and extends along the dorsum of the thumb to the head of the metacarpal bone the oval portion sweeping round it at the level of the web when the thumb is abducted and on the palmar aspect corresponding to the oblique crease at its root The remainder of the operation resembles that for removal of a finger Care must be taken not to wound the trunk of the radial artery as it passes through the base of the interosseous space the blade of the knife is therefore kept closely applied to the bone

2 By a *palmar flap* In this the knife is first carried across the dorsal aspect of the thumb from the centre of the web between it and the

index finger to a point on the palmar surface of the wrist just above the thenar eminence The knife is then rotated so that its cutting-edge looks outwards and is made to transfix the ball of the thumb in front of the metacarpal bone so as to emerge at the same spot in the centre of the web as that at which the dorsal incision commenced A muscular flap with a well rounded border is readily fashioned by cutting outwards The remaining soft parts are then divided and disarticulation is completed It is a prettier and more showy operation than the former but otherwise has no advantage

Amputations through the Wrist joint are seldom performed ex-



FIG 85 AMPUTATION OF THE WRIST BY ELLIPTICAL METHOD

The dark line indicates the palmar flap the dotted line the dorsal incision.

cept for injuries and are unsatisfactory from the prosthetic point of view the flaps must be derived as best they can from healthy tissues Three chief methods are however described (a) In the *elliptical* (Fig. 875) the incision takes the form of an ellipse the highest point being on the dorsum $\frac{1}{2}$ inch below the level of the wrist joint and the lowest in the centre of the palm 2 inches below the former On the ulnar side the incision passes between the pisiform bone and the base of the fifth metacarpal and on the radial side it crosses the carpo-metacarpal articulation After dividing the cellular tissue and dissecting up the palmar flap the joint is opened from the posterior aspect and the disarticulation completed The convex end of the palmar flap is fitted into the concavity of the dorsum, and the cicatrix thus forms a curved line on the back of the stump (b) A *long palmar flap* (Fig. 874 D) is sometimes utilized extending from just below either styloid

process down to about the middle of the metacarpal bones the sides of this flap being parallel to each other. The dorsal incision crosses the carpus horizontally between the two extremities of the former wound (Fig 873 D). The palmar flap is then dissected up so as to include only skin and subcutaneous tissue with perhaps a little muscular tissue from the thenar and hypothenar eminences. The wrist joint is opened from the dorsum and the amputation completed by the division of the flexor tendons. (c) In a few cases amputation by an *external flap* may be desirable (Dubreuil's method). The incision commences at the junction of the middle and outer thirds of the back of the wrist reaching down to the head of the metacarpal bone of the thumb terminating at a point in the palm immediately opposite its commencement. This flap is dissected up and should contain a certain amount of muscular substance from the thenar eminence. The skin and subcutaneous tissues on the ulnar aspect are now divided by a circular sweep of the knife around the inner side of the limb. Disarticulation follows and the external flap is carried inwards and sutured so as to close the wound.

Amputation through the Forearm is usually conducted by means of a flap operation the flaps being equal in length so as to secure a terminal scar. The muscles are divided circularly and the bones should be thoroughly cleared before division. The junction of the lower and middle thirds is the most favourable situation. This will leave room for an artificial arm with wrist mechanism and a removable hand in the place of which many different tools may be inserted. When the amputation must perforce be performed in the upper third it is well to remove the upper ends of the flexors and extensors of the wrist and fingers and of the supinator longus from their attachments to the humerus so as to leave as flat a stump as possible. The contraction of these muscles during flexion of the elbow causes the short stump to slip out of the socket of an artificial limb. The greatest care must be taken to divide the main nerves high and subsequently to keep the elbow extended and supinated.

Disarticulation of the Elbow-joint is an operation which should not be undertaken it has no advantages over one through the arm.

Amputation through the Arm may be carried out by any of the methods described *eg* the flap circular or modified flap and circular the choice in any particular instance being determined by the requirements of the case. The humerus should be divided about 6 or 7 inches from the tip of the acromion process to give the limb maker a most useful stump but even 1 or 1½ inches of bone will be useful and the operation is much preferable to disarticulation of the shoulder joint. Care should be taken to prevent an adduction contracture of the arm which is very liable to follow and lessens the subsequent utility of the part.

Disarticulation at the Shoulder-joint is now usually undertaken by an anterior racquet shaped incision (Fig 8/6). The third part of the subclavian artery may be controlled by digital compression the surgeon endeavouring to leave the division of the main vessels until the last stage of the proceedings but it is perhaps better to clamp all the smaller vessels as soon as they are cut and to isolate and tie the main trunks

before their division. A preliminary incision similar to that for excision of the shoulder is first made, extending downwards and outwards through the fibres of the deltoid, from the coracoid process. This passes directly down to the bone, and, if necessary, the joint is at once



FIG 876 — AMPUTATION
AT THE SHOULDER BY
ANTERIOR RACQUET

opened and examined prior to any further steps being taken. The surgeon, standing on the outer side of the limb, then carries his knife from the lower part of the incision downwards and inwards across the axillary folds around the limb to the point from which it first started, thus making the incision racquet-shaped. The skin is first dissected up all round for an inch or so, and then the muscles on the inner side, the deltoid in part, the pectoralis major, the coracobrachialis and biceps, are divided on the slant, thereby exposing the main vessels and nerves. The vessels may now be secured and divided, and the nerves isolated, pulled down and cut short, or they may be left intact till later. The

soft structures on the outer side of the vertical incision are next separated from the bone, and then the outer half of the capsule, together with the muscles inserted into the greater tuberosity of the humerus, and the long tendon of the biceps, are divided. The inner half of the capsule and the subscapularis are then cut through so as to free the head of the bone. By retracting the external flap and protruding the head from its socket, the posterior part of the capsule can be severed, and then the knife, travelling downwards between the humerus and the axillary vessels, is made to cut its way out, thus completing the disarticulation, the vessels and nerves, if not already dealt with, being divided as the last step in the proceedings. If the knife is kept close to the bone, the trunk of the posterior circumflex artery is not injured. Of course, an artificial limb after this operation has no functional value, but is merely ornamental.

Occasionally it is necessary to remove the whole of the upper limb, together with the scapula and outer third of the clavicle, for new growths, usually of a sarcomatous nature or for injury. This so-called Inter scapulo-Thoracic Amputation is best performed according to Berger's method. An incision is made along the clavicle, and the middle portion of this bone is then removed so as to enable the surgeon to divide between ligatures the subclavian artery and vein on a level with the lower border of the first rib formed by an incision (Fig 877) reaching from the centre of the former and extending downwards and outwards over the shoulder, across the anterior fold of the axilla, and as far as the lower angle of the scapula.



FIG 877 — INCISIONS FOR
THE INTERSCAPULO-THOR-
ACIC AMPUTATION

The anterior flap is then



FIG 878 —FOREQUARTER AMPUTATION

One of the results of this amputation is that the fitting of any appliance is extremely difficult for there is very little left upon which to obtain a good grip. No form of artificial limb is practical.

- A End result of amputation. B Side view. C Protective covering applied.
- D The squaring of the shoulder by the use of a protective covering.

(By courtesy of Mr F. R. Desoutter)

The pectorales major and minor are divided along this line, thereby exposing the brachial plexus, the constituent nerves of which are severed on a level with the section of the vessels. The axillary space can now be opened up along the outer surface of the serratus magnus. The limb is then rotated inwards and adducted across the trunk, and the patient drawn well to the edge of the table so as to enable the posterior incision, which unites the outer ends of the two former to be made. The flap thus marked out is dissected up, and the different muscles retaining the scapula in connection with the body are divided one after the other, including the trapezius, omo-hyoid, levator anguli scapulæ, rhomboids, and serratus magnus. These may be incised as near to the bone as is thought compatible with the total removal of the growth. Any remaining fibres are cut across, and the limb is thus detached. In cases of new growth there may be a large number of vessels, both arteries and veins requiring ligature, but in a healthy limb removed for injury none but the posterior scapular and suprascapular will give any trouble. Naturally, such an operation is accompanied by some amount of shock, but the results usually obtained have been very gratifying.

A limb-maker will supply a light protective covering which will square the shoulder and support the coat, though no form of limb is practical (see Fig. 878).



FIG. 89 — FARABÆUF'S AMPUTATION OF THE GREAT TOE (TREVES AND WAKELEY'S OPERATIVE SURGERY.)

Amputations of the Lower Extremity.

Amputations of the Toes at the metatarso-phalangeal articulations are precisely similar to the analogous operations for the fingers. It must be remembered that the joint lies as far behind the web as the apex of the toe is in front of it, and hence the incision must start farther back than might be expected. A solitary toe should never be left, as it always becomes troublesome, owing to lateral displacement. This applies even to the big toe.

The heads of the metatarsals should always be saved, if possible. For the removal of the great toe from the metatarsal bone, *Farabæuf's* operation is the best. The incision (Fig. 879) commences over the head of the latter bone, and well to the mesial side of the extensor tendon, it extends downwards nearly as far as the interphalangeal articulation, and then crosses the plantar surface of the toe so as to reach the centre of the web between it and the second toe, thence the knife is carried straight back to the commencement of the incision. These cuts are deepened, the tendons divided, the joint opened, and the toe removed. It will then be found that an internal flap remains, which can be brought across the head of the metatarsal bone, and covers it in so that the L shaped cicatrix is not exposed to pressure.

Amputation of the great toe at the tarso-metatarsal articulation is conducted either by a racquet shaped incision, or by dissecting up



1 AN C PART 9 IMPUTAI N

The 1st A.I. is a 1st Lt. to which I have a report. There is also an engine and two stump pullers in the material line. The type of a shovel, an engine, a gear and a wheel are also in the line.

Here we try { Mr J. R. Jewett et }

a flap from the inner side. It is a bad operation, leaving a terribly mutilated foot and should if possible never be undertaken.

Amputation of all the toes is occasionally required in bad cases of pes cavus. The operation is best conducted by cutting dorsal and plantar flaps which after removing the toes, are united over the heads of the metatarsal bones.

Amputations of the Foot used to be performed—

(a) At the tarso-metatarsal articulation by Lisfranc's or Hey's operation

(b) At the mid tarsal joint by Chopart's operation

(c) At the sub-astragaloid joint

But owing to the impossibility of fitting a satisfactory appliance to the stumps resulting from these operations they should not be undertaken (see Fig. 880).

Amputation of the Foot—Syme's amputation consists of a disarticulation at the ankle-joint, together with removal of the two malleoli and the articular surface of the tibia. It is by far the best of all ampu-



FIG. 881.—LINES OF INCISION IN BONES AND SOFT PARTS IN SYME'S AMPUTATION.

A. A' Incisions for Syme's amputation.
S. section of tibia and fibula.



FIG. 882.—ELLIPTICAL INCISION IN MODIFIED SYME'S OPERATION.

tations in the neighbourhood of the ankle. The patient lies on the back with the leg well elevated and projecting over the end of the table; the surgeon standing either below or a little to the right of the patient. Having exsanguinated the limb the operation is on the right foot, commenced by making an incision from the tip of the external malleolus down to the heel and extending up to a point $\frac{1}{2}$ inch below and behind the internal malleolus (Fig. 881, A). On the left side the incision is made in the opposite direction. For this purpose a short handled strong bladed knife should be employed (an ankle knife). The incision is directed slightly backwards otherwise a bucket shaped heel flap is formed in which discharges may collect. The knife is carried down to the bone at the first cut and the surgeon then proceeds to dissect up the heel flap thus marked out by inserting his thumb into the wound and partly peeling partly cutting the soft tissues from the back of the os calcis. This is sometimes a tedious and tiring proceeding since it is most important to keep close to the bone for fear of dividing the nutrient vessels of the flap (external and internal calcanean). The dorsal incision (A) is then made uniting the ends of the former wound and carried slightly forwards so as to mark out a short convex flap

This is dissected up and the ankle-joint opened the line of the articulation being placed $\frac{1}{2}$ inch above the tip of the internal malleolus. By division of the lateral and posterior ligaments of the tendo Achillis and of the few remaining fibrous connections along the top of the os calcis the foot is removed. The lower ends of the tibia and fibula are then cleared and sawn off (S) the ends of the dorsal flap being meanwhile held out of harm's way. The main vessels are tied as also any other bleeding points the tendons and chief nerves are drawn down and cut short and the wound closed by sutures provision being made for drainage through one of the angles.

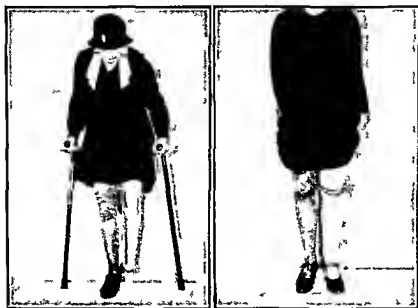


FIG 883—SHOWING MODIFIED SYME'S AMPUTATION

Contrast the neat contour of the stump and the extra clearance between the end bearing and the ground with Fig 884. The light metal limb fitted although slightly wider than the natural ankle is quite neat
(By courtesy of Mr F R Desoutter)

A much quicker and prettier method of performing this operation consists in making an elliptical incision (Fig 882) and opening the joint and disarticulating whilst the os calcis is subsequently dissected out of the heel flap from above keeping the knife close to the bone.

The modern practice is to cut the tibia and fibula about 1 inch above the articular surface of the tibia (Fig 883). This is somewhat higher than the old fashioned method (Fig 884) and is desirable because

(a) It leaves sufficient room for a mechanical ankle joint in the artificial limb

(b) There is less loose flesh and therefore less likelihood of the end bearing pad loosening

(c) The terminal increase in circumference of the stump is still great enough to be of value in holding the artificial limb in place and is far less ungainly than when the bones are sectioned lower down.

The Syme's amputation has been condemned more particularly by surgeons who gained experience during the late war, when many operations were performed in unfavourable conditions. A good Syme's will give excellent results with the advantages that the patient takes weight on skin already used to pressure and there is very little

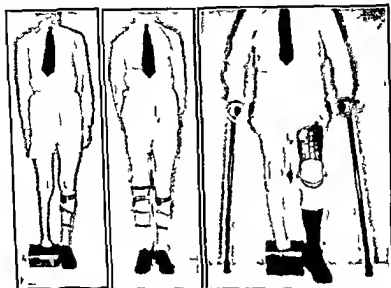


FIG 884

FIG 885

FIG 884—ORTHODOX SYME'S AMPUTATION

Note the great increase in terminal circumference of this stump. The heel pad is liable to loosen and become painful. The light metal limb fitted to this case is necessarily very much wider than the natural ankle.

FIG 885—SYME'S AMPUTATION ON A BOW LEGGED PATIENT DEMONSTRATING CLEARLY THE DIFFICULTY OF CONSTRUCTING AN ARTIFICIAL LIMB WITH CORRECT ALIGNMENT.

(By courtesy of Mr E. R. Desoutter.)

shortening so that he can in emergency walk on the bare stump. It is contra indicated in cases where there is reason to suspect there may be circulatory trouble and in bow legged patients (Fig 885) and is not on the whole recommended for women because even the best appliance must be a little wider than the natural ankle.

Amputations of the Leg should be undertaken if possible 7 inches for a man and 6 inches for a woman below the articular surface of the knee-joint. On a tall patient 1 inch longer than this is an advantage (Fig 886). A longer stump is not satisfactory because it does not

allow of proper alignment of an artificial limb. In addition there is frequently vascular trouble. Shorter stumps to a minimum of 2 inches of tibia though not ideal can give good enough results to make it well worth while saving the knee joint (Fig 887). Almost any operation may be practised according to the needs of the case but the most satisfactory is that by means of antero internal and postero external flaps the former being the longer so as to bring the scar well behind. After the first inch or two the flaps should be rapidly deepened so as to include all the muscles. In dividing the bones care must be taken not to leave a sharp projecting edge on the front of the tibia. This is

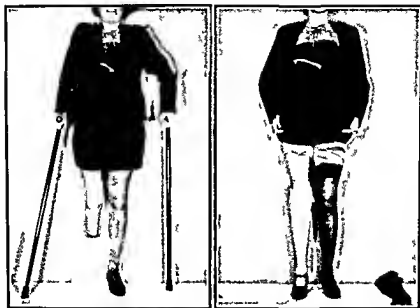


FIG 886—AMPUTATION BELOW THE KNEE OF IDEAL LENGTH AND CONTOUR ALLOWING THE LIGHT METAL LIMB TO BE MADE TO MATCH THE NATURAL LEG A VERY IMPORTANT POINT FOR A WOMAN

(By courtesy of Mr E R Desoutter)

best prevented by partially sawing through the bone in an oblique direction from above downwards and when this has reached a little beyond its centre the saw is withdrawn and a horizontal section made cutting across the oblique incision in such a way as to remove a wedge of bone from the front of the tibia which thus becomes suitably bevelled. The fibula should always be divided before completing section of the tibia and should be about 1 inch shorter than the tibia to leave a rounded end to the stump. With short stumps it is not advisable to remove the fibula completely as is sometimes advocated because this alters the shape of the stump from triangular to circular and the triangular shape is extremely useful in helping to prevent an

artificial limb from rotating. Also the scar left after the excision does not bear pressure. In cases where the fibula is very prominent it is preferable to shave the head by means of a posterior circular incision which will obviate the risk of an adherent scar.

Disarticulation through the Knee-joint and supra-condylar amputation of the thigh (Carden's, Lister's, Gritti's, Stokes' are various methods) are seldom performed and are unsatisfactory because

- (1) They leave no room for an internal mechanical knee joint
- (2) The bony end of the stump is greater in circumference than the fleshy part immediately above it and in the case of disarticulation of



FIG. 887.—DOUBLE AMPUTATION BELOW THE KNEE

The right stump shows the minimum length to which it is possible to fit a below-knee type limb.

(By courtesy of Mr. E. R. Desoutter.)

the knee necessitates a limb with a leather lacing socket which is heavy and hot.

- (3) The external mechanical knee-joint is wide and ungainly.

- (4) The skin flaps are thin and of poor quality and thus healing may not be satisfactory.

Amputation of the Thigh may be conducted by any of the general methods already described but Lister's operation modified flap and circular (Figs 865 and 866) is the best.

The length of femur varies according to the height of the patient but on an average 9 to 11 inches of stump measured from the perineum is ideal (Fig. 888). With longer stumps not only do difficulties of

circulation arise but there is not room for a mechanical knee-joint and the terminal increase in circumference of the lower end of the femur makes it impossible to fit a limb with a taper socket. Shorter stumps with as little as 3 to 4 inches of femur can be satisfactorily fitted with above knee type limbs. Stumps with less femur than this have to be treated as cases which have been disarticulated through the hip and are fitted with the tilting table type of limb but it must be emphasized that even 1 inch of bone is valuable when it comes to fitting this type of limb (Fig 889)

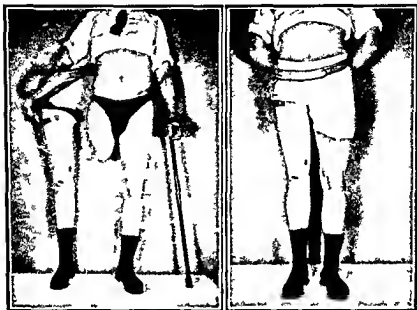


FIG 888—ABOVE KNEE AMPUTATION OF IDEAL LENGTH AND CONTOUR

Note the taper shape of the stump which is so valuable for the fitting and control of the artificial limb also that the light metal artificial limb is suspended by a pelvic band only with no chest or shoulder harness

(By courtesy of Mr E R Desoutter)

Disarticulation through the Hip joint is always an operation of the greatest gravity and every precaution should be taken to minimize the immediate risks by preventing hæmorrhage and lessening shock. No part of the body should be unnecessarily exposed moreover the head is kept low and although the operation must not be hurried over no time is wasted

Formerly several different methods of operating were described but most of them are now discarded in favour of the *Anterior Racquet* operation (Fig 890). Of course it is occasionally necessary for some other plan to be adopted but the surgeon must use his own ingenuity in devising them to meet the requirements of the case. No



FIG 889 — AMPUTATION AT THE HIP

The shape of the stump shows clearly the value of saving even 1 or 2 inches of femur. The shape of the hip is retained and provides a much better grip for the artificial limb than disarticulation.

(By courtesy of Mr E. R. Desoutter.)

special means need be employed for securing hæmostasis as the main vessels are secured in the early stages of the operation and all others are compressed by pressure forceps as they are divided.

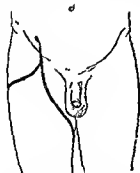


FIG 890 — AMPUTATION THROUGH HIP-JOINT BY ANTERIOR RACQUET INCISION

The incision commences over the centre of Poupart's ligament and is carried down along the course of the main vessels for about 3 inches. The common femoral sheath is exposed and both artery and vein are secured by double ligature and divided. The incision is then completed: it sweeps over the inner side of the thigh 4 or 5 inches below the perineum to the back and is brought up again to the front 3 or 4 inches below the great trochanter. The muscular structures in the outer flap are then cut through and the external circumflex artery and other

bleeding vessels secured by pressure forceps *en route*. By rotating the limb inwards the insertion of the gluteus maximus can be divided.

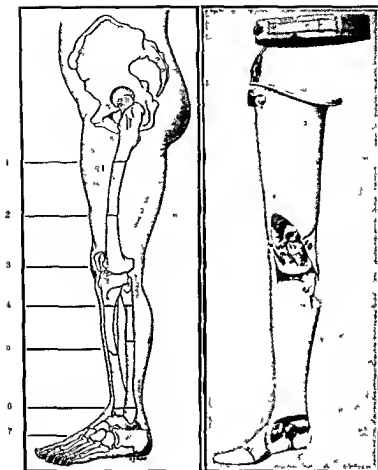


FIG 891—AMPUTATION SITES OF THE LOWER EXTREMITY

An artificial leg (Desoutter) is shown for comparison demonstrating in section the space required for the knee and ankle mechanism

- 1 Minimum of 3 to 4 inches of femur valuable for above knee type limb but every inch of bone above this very valuable for through hip type 2 stump of 9 to 11 inches measured from the perineum is the most satisfactory 3 amputations at or immediately above knee undesirable for prosthesis 4 tibia 2 inches long the minimum which can be used for below knee type limb—in this case the fibula must, of course be of equal length 5 tibia 7 inches long with fibula 1 inch shorter gives best results in below knee cases 6 modified Symes—very satisfactory in selected cases 7 all partial foot amputations undesirable for prosthesis

The sites of amputation indicated in the diagram are necessarily only approximate (see text)



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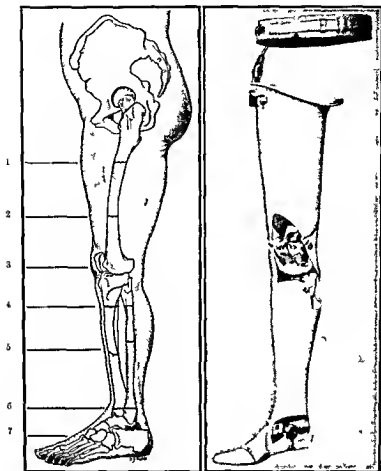


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- 6 modified Symes—very satisfactory in selected cases
- 7 all partial foot amputations undesirable for prosthesis

The sites of amputation indicated in the diagram are necessarily only approximate (see text)

as also the muscles attached to the great trochanter. The muscles in the inner flap are then similarly dealt with after rotating the limb outwards the internal circumflex artery etc being secured. The capsular ligament is next divided transversely and the head of the bone disarticulated. Finally the limb is rotated forcibly outwards and all the soft parts at the back of the limb including the sciatic vessel and nerves are divided from within outwards with one sweep of the knife. The wound when sutured lies antero-posteriorly. After this operation an artificial limb of the *tilting table* type can be fitted and excellent results have been obtained (Fig 88g).

At a glance the various sites for amputation may be visualized by looking at Fig 89i.

CHAPTER XLVIII

ANÆSTHESIA

By C F HADFIELD MBE MA MD DA

THE medical student accustomed to the orderly routine of an operating theatre scarcely realizes that the anæsthesia which enables the surgeon to perform his delicate tasks is of comparatively recent origin. Less than a hundred years ago a true anæsthetic—one of God's best gifts to His suffering children—was unknown and surgical operations had to be performed with the utmost rapidity on patients whose sensations of pain were limited only by narcotic drugs and a merciful syncope. In the history of anæsthesia there are three dates occurring curiously close together which all medical men should bear in mind. The first medical use of nitrous oxide as an anæsthetic was in 1844 and is associated with the names of Wells, Rigg and Colton. Ether was first used for this purpose by Morton (at the suggestion of Jackson) in 1846 and lastly chloroform anæsthesia was discovered in Edinburgh by Simpson in 1847. Although it is true a few other anæsthetic agents such as ethylene and ethyl chloride are now available yet after some eighty years of investigation the vast majority of anæsthetics given to day depend on one or other of the three drugs introduced in the years 1844 1846 1847.

The object of an anæsthetic is to enable various painful and unpleasant procedures to be performed on a patient without pain or distress. This can be effected either by rendering the patient unconscious by the administration of a suitable agent by inhalation or otherwise—that is by true anæsthesia or by the injection of various drugs which temporarily destroy the sensation of the part operated upon either by acting upon the nerve endings affected (*local anæsthesia*), or by blocking the conductivity of the larger nerve trunks which supply the part (*regional anæsthesia*). In the two last cases the patient may remain quite conscious and the condition is not strictly one of anæsthesia but of analgesia. The terms local and regional anæsthesia have come into such general use that it is almost pedantic to attempt to eliminate them.

General Anæsthesia—In administering a general anæsthetic the anæsthetist has his obligations to the patient and to the surgeon. With regard to the patient the duty of abolishing pain is obvious but further than this he must do his best to render the induction as free from discomfort as possible and also he must select and manage his agents so that the patient's recovery shall be as little unpleasant and as free from disturbing sequelæ as he can contrive. His chief obligation to the patient however, is so to watch over his own and the

surgeon's manipulations that danger to life shall be reduced to the minimum. If necessary the surgeon must be warned to stop or at least curtail his operation should the condition of the patient require it. This should seldom be necessary. Active co-operation must exist between the surgeon and anæsthetist and just as the latter will rely on the former to avoid all unnecessary shock by the manipulation of sensitive parts as delicately as possible so the surgeon should be able confidently to depend upon his anæsthetist for timely information as to the general condition of the patient. In addition the anæsthetist can help the surgeon in many ways. He will select and administer his anæsthetic so as to facilitate the surgeon's work and as far as is consistent with the safety of the patient he will secure adequate muscular relaxation for the performance of the operation.

Stages and Signs of Anæsthesia.—The ideal induction of anæsthesia requires a gradual and uninterrupted transition from a condition of ordinary consciousness to one of complete unconsciousness combined with immobility and muscular relaxation. Although this change should be made by imperceptible steps it has been found convenient to divide it into several stages for descriptive purposes. These are as follows:

1 **Disordered Consciousness.**—Although still conscious the patient's higher cerebral centres have become so affected that judgment is lost and all faculties are disordered and unbalanced. The senses may be abnormally acute, and things seen and heard may be vividly remembered afterwards. The physical condition may be little altered, but a nervous patient may become pale and restless with rapid pulse and possibly dilated pupils.

2 **Excitement.**—The disturbance already described is accentuated. The patient loses grasp of his surroundings and perhaps dreams he is elsewhere and begins to shout and struggle. Any holding of the breath will cause cyanosis and accentuate struggling. With free respiration the colour is good and the pulse full and perhaps rapid and the blood pressure raised. A dilating pupil with pallor probably indicates impending vomiting. This is the troublesome stage of the induction and skill and experience are required to exclude it or pass through it quickly and yet without so hurrying the dosage as to cause respiratory spasm.

3 **Surgical Anæsthesia** is characterized by the patient becoming completely unconscious and motionless the breathing should be deep and automatic. The blood pressure should be about normal a little raised with ether and possibly a little lowered with chloroform. The reflexes should be sluggish or absent and the muscles relaxed. The patient is now ready for the operation.

4 **Deep hærcosis.**—If the dosage is pushed still further the anæsthesia will deepen and soon pass the limits of safety. All the superficial reflexes will long have disappeared the colour will vary from pale to grey the pulse is rapid thready and possibly irregular the breathing will lose its automatic character and there will be lengthening pauses between expirations and the following inspirations. Finally respiration ceases altogether but fortunately the pulse usually continues for some

little time after this has happened, the blood pressure falls lower and lower, the pulse becomes impalpable, and the pupil widely dilated, and death follows.

There are many signs indicating the depth of anæsthesia, and thus is fortunate as no one of them by itself is quite reliable. The three on which the greatest reliance can be placed are

1 **Automatic Breathing**, which is more easy to appreciate than to describe. The respiration is deep, usually audible and mechanical in its regularity; there is scarcely a pause between an expiration and the following respiration. The advent of any such pause should be at once apparent to the trained ear as it indicates that the anæsthesia is becoming either too deep or too light, and suitable steps must be taken accordingly.

2 **Diminution or Absence of Reflexes**—The lid reflex will disappear early, the conjunctival reflex later, and the corneal last of all, the corneal reflex need only be abolished for deep anæsthesia. The size of the pupil and its reaction to light are of some value, which is largely discounted by the action of alkaloids. Whether the pupil is dilating or contracting is information of more value than its actual size. With ether a large pupil is not in itself a danger sign provided that colour, pulse, and breathing are satisfactory. With chloroform a large pupil always suggests danger and should not be allowed to remain uncorrected.

3 **Muscular Relaxation** is the sign of anæsthesia to which the surgeon attaches the greatest importance. The degree required naturally varies with the site and nature of the operation, for all skeletal muscles do not necessarily relax simultaneously or equally. The anæsthetist will obtain useful information from the condition of the sterno mastoid and masseter muscles which are fairly reliable guides and conveniently placed for observation. It must be remembered that muscles near painful and inflamed areas (those in which the surgeon is most interested) are 'on guard,' and remain rigid long after others have relaxed.

The Airway.—The success of an inhalation anæsthetic is chiefly dependent on maintaining a perfectly free air passage through the mouth and nose, glottis, trachea, and bronchi, to the pulmonary alveoli. If this 'airway' is free, the anæsthesia is usually uneventful, but it is very liable to be obstructed, and its maintenance is not always easy.

A frequent trouble is the accumulation of mucus and saliva in the back of the pharynx. This can be overcome firstly by preliminary medication with atropine, and secondly by providing for free drainage out of the mouth by turning the head well to one side, periodically pressing out any secretion that has accumulated in the cheek, and possibly by arranging the corner of a towel in the mouth to act as a drainage wick. Mopping the pharynx with swabs should be a last resort, for the immediate relief is disappointing, and the irritation causes increased formation of mucus.

Another cause of obstruction to the airway is the falling back of the tongue on to the posterior wall of the pharynx when the action of the anæsthetic relaxes the muscles forming the floor of the mouth. In this way the glottis is brought into contact with the soft tissues at the back

of the throat, and the passage through it is narrowed or occluded. By turning the head to one side, as recommended above, this may be partly avoided, as the tongue then tends to fall to the side rather than back wards; if this is insufficient, it becomes necessary to hold the tongue forward. It often suffices to place a finger behind the angle of the jaw on one or both sides, and press forward the whole jaw with the tongue attached to it, but it may be necessary to pull the tongue bodily forward with forceps, although this is undesirable. Most of these difficulties can be obviated by the use of the modified Hewitt's artificial airway shown in Fig. 892. The flattened aluminium ring rests between the gums or teeth, the curved rubber tube holds the tongue forward in its concavity, and the soft open end should lie immediately over the glottis. Even with the airway in position it may be necessary to hold the jaw forward by slight pressure with the finger.

Laryngeal Spasm is another cause of obstruction, and is less amenable to treatment. During inspiration the vocal cords do not open sufficiently to allow free passage to the inspired air, which only gains admittance with difficulty and with a crowing sound. The condition is often due to the irritation of too strong a vapour presented at an early

stage, but even with the greatest care it cannot always be avoided. There is no ready method of overcoming it. With patience and a modulation of the vapour it usually passes off. Contrary to expectation a change from ether to chloroform accentuates rather than relieves it. The obstruction may be

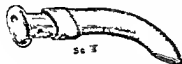


FIG. 892.—MODIFIED HEWITT'S AIRWAY

lessened by keeping the head rigidly in the middle line rather than to one side, as recommended above.

Obstruction to the airway may also be due to tumours and foreign bodies (such as vomited material), and each must receive appropriate treatment. Foreign bodies may be removed by the finger or by inserting the patient, but in urgent cases a laryngotomy or tracheotomy may be required.

Preparation of the Patient for Anaesthesia.—In emergency cases no adequate preparation is possible, and it is remarkable that the anaesthesia usually runs a trouble-free course. If the stomach is obviously distended with food an emetic may be advised, although the act of vomiting, especially when artificially induced, has a most debilitating effect. Even when there is ample time, the drastic methods of preparation formerly considered essential are now modified. A mild aperient is administered about thirty-six hours previously, followed by an enema on the evening before operation. In rectal cases, however, in spite of its disadvantages the morning enema is essential. The diet also need not be too rigidly controlled. The previous day the food should be of an ordinary nature, but selected with a view to its easy digestibility. A light and digestible dinner may be taken the night before, and in the early morning a cup of tea with perhaps a little toast or thin bread and butter. The replenishment of the carbohydrate reserves of the body

by liberal doses of glucose or barley sugar is of great service in the prevention of post operative vomiting and acidosis. The object should be to avoid the arrival in the operating theatre of a patient debilitated by the combined effects of purging, starvation, and the action of a recent enema.

Preliminary Hypodermic Medication—A hypodermic injection of Atropine is now almost universally given before operation so as to diminish the secretion of mucus, etc., in the air passages, to decrease sweating and so prevent loss of heat and also possibly to discourage vagal inhibition of the heart. Since its use has become general post-operative vomiting has also decreased. Before ether, atropine must never be omitted, and should be given in full doses—up to $\frac{1}{8}$ grain for adults, and $\frac{1}{16}$ grain for children.

Morphine may be helpful but its action is so variable that it is best avoided as a routine. It must never be given to children, and is best omitted when chloroform is to be used. With some patients it enables operations to be performed with a minimum of anæsthetic but its depressing action on the respiratory centre diminishes the depth and frequency of the respirations, and so definitely limits the amount of anæsthetic inhaled. As a result, deep sleep rather than true anæsthesia follows, and an incision may cause movement and strain. On the other hand, with very nervous patients a preliminary small dose ($\frac{1}{8}$ grain) undoubtedly adds to their comfort, and is scarcely sufficient to have any ill effect.

Scopolamine (hyoscine) is usually combined with morphine and atropine, and is not free from the disadvantages of the former. The combination is frequently used to obtain better results with pure gas-oxygen anæsthesia, and it is also useful to obtain 'twilight sleep' when local or regional analgesia is used. It has a remarkable effect on memory and patients who seem quite unaffected by it during an operation (local) may have a very hazy recollection of events on the following day. The dose is $\frac{1}{16}$ to $\frac{1}{8}$ grain. A disadvantage is that occasionally it acts as a deliriant rather than a sedative.

When any of these drugs are used, the effect on the pupil during anæsthesia must not be forgotten. Atropine and scopolamine dilate the pupil, and morphine contracts it, the effect of mixtures cannot be foretold, and varies with different patients.

After-Treatment—The patient should be put back to bed with as little disturbance as possible and with the head turned to one side, so as to allow the escape of any mucus or vomit. If an airway has been used, it should be left in position until it is quite certain that the patient can breathe freely without it. The patient must not be left until he is conscious. The bed in which he is placed should be previously warmed, but hot water bottles must be removed or protected from any possible contact with him. The necessity for any rectal, subcutaneous, or intravenous injections of saline, etc., will be discussed with the surgeon.

Post-operative Vomiting is best treated by encouraging the patient, when sufficiently conscious, to drink a half pint or more of warm water, with or without bicarbonate of soda, thus, if retained, replenishes the

depleted fluids of the body, and if returned acts as an efficient stomach wash-out. In obstinate cases a few drops of tincture of iodine may be added to a tumbler of water or mustard leaves or a small blister may be applied to the epigastrium. Small pieces of ice in the mouth may be tried, but are seldom very effective. Sips of coffee are serviceable but champagne is often far more successful than anything else. The salts of bismuth and other similar gastric sedatives may be tried, but if the vomiting continues long enough to suggest their use, the possibility that it is due to some surgical cause must be considered. The presence of radium in the body, and especially in the cavity of the uterus may cause continuous vomiting until it is removed.

Delayed Chloroform Poisoning or Pernicious Vomiting is a most serious condition, very occasionally following the administration of chloroform and still more rarely of ether or other anesthetics. It may supervene after ordinary post-anæsthetic vomiting which gradually becomes worse, or there may be little or none at first, and the vomiting only commences after an interval of twelve hours or so and then it becomes steadily more alarming. The vomited material, at first mucus and froth becomes darker in colour and resembles coffee-grounds. The patient is restless or comatose, or both and later becomes jaundiced. The breath smells of acetone and the urine, if any, contains acetone and hydroxybutyric and diacetic acids. The clinical picture is very much that of acute yellow atrophy of the liver, and the post mortem findings are similar. The treatment is symptomatic only and of little use, as the condition once well established, is almost always fatal. Intra-venous injections of insulin and glucose and alkalies give the only hope. It seems to be closely associated with acidosis, and so is rather more frequent in septic cases. On the other hand septic cases exhibiting marked acidosis are often safely anesthetized. The chemistry and pathology of the condition are by no means clear but probably it originates in some profound metabolic disturbance associated with acidosis the chloroform (or other anæsthetic) being not so much the causative agent as the trigger which explodes the charge.

Nitrous Oxide, N_2O —Nitrous oxide is undoubtedly our safest anæsthetic. It is practically non-toxic and as it is expired uncharged it leaves no irritating decomposition deposits in the body. It is supplied in cylinders of varying capacity in liquid form at a pressure of 30 atmospheres. Nitrous oxide is much used for dental extractions, the incision of abscesses and the manipulation of stiff joints. For these purposes the cylinders are connected by tubing with a rubber 'Cattlin's bag' between which and the face-piece is placed an arrangement of valves. This gives three positions: in the first 'air,' the nitrous oxide is kept in the bag and the patient breathes air only; in the second position valves the patient inspires gas from the bag and expires it into the open air. In this position the bag will become rapidly emptied unless the supply is constantly replenished by admitting more gas by turning the foot key. In the third position, 'no valves,' the patient simply breathes in and out of the bag a process described as rebreathing. For a short anesthesia it is sufficient to allow the patient to breathe gas in the valves position, exhaling it into the air,

until the automatic breathing, the soft stertor, and the fixation of the eyeballs show that he is unconscious. The mask can then be removed, and the anæsthesia should last long enough for the extraction of one or more teeth. In this simple method it is obvious that the patient receives no oxygen, and a certain amount of cyanosis results. It is better to combine the nitrous oxide with some air or oxygen. This gives a slightly longer induction, but also a longer anæsthesia, as more nitrous oxide can be introduced into the blood without cyanosis. Air can be given by occasionally lifting the face-piece (or moving the valve). Alternatively, a suitable amount of oxygen can be introduced into the bag from a separate cylinder. There are various devices for doing this, that in most frequent use being Hewitt's apparatus, which has one bag for nitrous oxide and another for oxygen. There is a special valve which, provided that the two bags are about equally distended will supply the patient with any proportion of oxygen up to 10 per cent.

A longer dental anæsthesia can be obtained by replacing the ordinary face-piece by a small one which covers the nose alone as soon as the patient is unconscious. Through this the patient is supplied with gas under some pressure during the whole time that the dentist is at work. This can be combined with oxygen as before. A better way for patients with free nasal passages (an essential for all nasal gas) is to employ the nose piece throughout, the patient being instructed to inspire through the nose and expire through the mouth. The patient thus supplies his own valves, and, if intelligent, will usually do so efficiently. This rhythm, once established, is likely to continue during unconsciousness. If, however, oral inspiration begins, it can be prevented by covering the mouth with a special small pad fitted with a valve that allows expiration only. By the skilful use of this nasal gas (with oxygen) the patient can be kept under for many minutes, and the dentist can perform his extractions carefully and deliberately.

For short operations unconnected with the mouth or nose the patient can be kept under more easily, as it is unnecessary to remove the face piece. The reaction of patients to nitrous oxide is rather variable, but those who take it well can be kept under its influence with the simple apparatus described for considerable periods, provided they are adequately supplied with air or oxygen. One great advantage of nitrous oxide is the relative absence of objectionable sequelæ. After a short inhalation the patient recovers consciousness almost immediately, and is usually able to resume his ordinary avocations within a few minutes. There is seldom vomiting, or even nausea. With longer inhalations the after-effects are a little more noticeable, but still very much less than those of any other anæsthetic.

In major surgery, the method already described has not been found suitable, since the amount of gas employed is excessive, moreover, with nitrous oxide and oxygen alone it is usually difficult, and often impossible, to obtain sufficient muscular relaxation for abdominal operations. This depends on the physical fact that at ordinary atmospheric pressures the blood cannot take up sufficient nitrous oxide for really deep anæsthesia. Devices for administering the gas under increased pressures are theoretically possible, but have not attained

much success in practice

It is found however that if the nitrous oxide is combined with small quantities of ether vapour a relaxation can be obtained out of proportion to the amount of ether used whilst if the ether vapour is replaced or reinforced by a little chloroform the effect is even more marked To enable this to be done with ease and also to secure better control of the proportion of gas and oxygen various machines have been devised The Boyle gas-oxygen-ether apparatus shown in Fig. 893 consists of a stand holding the necessary cylinders each of which is fitted with a fine adjustment valve which controls the rate of flow by a touch Each gas is led by tubing to a sight feed composed of a glass cylinder of water in which are immersed metal tubes pierced by small holes at equal intervals According to the rate of flow the gas will bubble out of one or two or more holes and this can be controlled by the valve the proportion of the two gases can be adequately but not quite accurately measured in the same way Thus if the nitrous oxide is bubbling out of four holes and the oxygen out of one the administrator knows that he is delivering to the patient a mixture composed of about

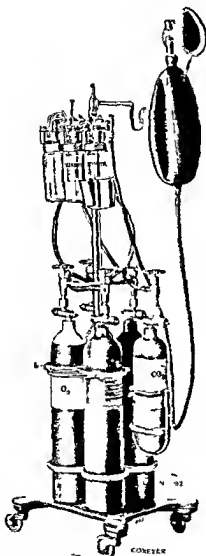


FIG. 893.—BOYLE'S GAS-OXYGEN ETHER APPARATUS

four parts of N_2O and one part of O_2 or in other words an atmosphere in which the nitrogen of the air is replaced by nitrous oxide this in

practice is a very useful proportion. Next to the sight feed are two other bottles the larger of which may contain ether and the smaller chloroform. At the top of each of these is a tap and a plunger, by the manipulation of which it can be arranged that the combined gases issuing from the sight feed shall pass straight across without coming into contact with the ether. By varying their position, however, the gases can be made to pass over the surface of the ether, or, alternatively, actually to bubble through it. In this way the anæsthetist can at will administer pure gas and oxygen or these gases fortified with an amount of ether varying from a minimum up to the maximum of the capacity of the machine. The chloroform bottle is similar. The ether bottle is provided with a container by means of which it can be surrounded with hot water to check the freezing due to the rapid evaporation. It is also usual to add to the apparatus a cylinder of CO_2 with its own sight feed by means of which a small proportion of this gas can be added as required. In actual use the apparatus is quite simple, although considerable experience is required to obtain the best results.

Induction is commenced with a mixture of gas and oxygen in the ratio of 6 : 1, and the valve is turned almost at once to the rebreathing position, which will be maintained to a large extent through the proceedings. If the bag becomes too full or if prolonged stertor occurs, it must be temporarily varied, and indeed, in most cases it is wise to revert to the 'valves' position at intervals. Although the best immediate results are obtained by practically continuous rebreathing, yet unpleasant after results, such as nausea and vomiting, are liable to follow. The induction by this method is somewhat slow, but after some minutes consciousness is lost and deeper anæsthesia can be hastened by occasionally turning on ether for a few breaths. The ratio of the two gases should gradually approximate to the 4 : 1 mentioned above but the actual amount of oxygen must be regulated by the colour of the patient. Provided that it is not due to an obstructed airway, the least cyanosis must be treated by an increase of oxygen. Too much oxygen will lighten the anæsthesia and cause movements, but this should be no excuse for cyanosis. If the anæsthesia is insufficient while the patient is breathing freely and has plenty of nitrous oxide, it is better to deepen it by the use of a little ether than by diminishing the oxygen. The necessity of using the ether must be intelligently anticipated as, if adopted too late, it will cause coughing and straining. If with an open airway, satisfactory breathing, and the gases bubbling through the ether the anæsthesia is still too light, it may be necessary to resort to chloroform. This however, should be seldom done, and always with the greatest care. Chloroform administered by a closed method is never safe, and thus is essentially a closed method. The chloroform must only be turned on for brief periods, during which the patient is most carefully watched for any sign of overdose. Both ether and chloroform should be turned off as soon as they can be dispensed with—a point worth emphasis, as it is surprisingly easy to continue them by inadvertence long after they are really required. A proportion of nitrous oxide and oxygen suitable for the case having

been once determined, it is seldom advantageous to alter it much, but the sight feed must be watched constantly to see that a regular flow is maintained. In every case of gas oxygen (ether) anaesthesia atropine should be given beforehand, and the addition of full doses of morphine and scopolamine usually assists materially in obtaining good relaxation. Often, however, by depressing the respiratory centre, these drugs shallow the breathing to such an extent that an insufficient amount of the gases is inhaled for satisfactory anaesthesia. They are then worse than useless. Fortunately, if a supply of CO_2 is available, the addition of a small proportion will counteract this tendency.

Ether, $(\text{C}_2\text{H}_5)_2\text{O}$ —Ether may be considered the most generally useful anaesthetic that we possess. It is many times safer than chloroform, and should be used in its place, unless there is some definite reason to the contrary. Owing to its irritant qualities, ether is apt to cause breath holding and struggling if exhibited in too strong a vapour, but if properly administered, it acts as a stimulant to both respiratory and circulatory centres. The respirations are increased both in rate and depth, and the blood pressure rises in spite of the fact that there is also some vaso-dilatation. This last effect, combined with the rise in blood pressure, sometimes causes an erythema known as ether rash, which however is transitory and unimportant. A more serious consequence is the tendency to increased bleeding, although this is not necessarily a defect as it is better for the surgeon to see and arrest bleeding at the time of operation than to be faced later with the possibility of reactionary hæmorrhage. In certain operations especially those on mucous membranes however, the continued oozing may so mask the field that it becomes necessary to change the anaesthetic. The stimulating effect of ether on the vital centres naturally becomes progressively less and after the administration has proceeded for some time the blood pressure will return nearly to the normal, though the respiratory rate remains raised. If the ether is continued longer, and especially if the dosage is excessive, the centres are affected by a reactionary depression, the blood pressure falls, and the respiration becomes shallower less regular, and if the anaesthetic is pushed still further ceases altogether. Fortunately, in nearly all cases the respirations stop long before the heart beats and though the condition is serious and certainly inconvenient it is seldom really dangerous as it should quickly yield to artificial respiration and other appropriate measures.

Ether however, is not without its disadvantages. In the first place, its vapour is highly inflammable, and for this reason it must never be used in the proximity of any open flame, or when any form of cautery or diathermy is to be employed near the patient's respiratory tract or within reach of his expirations. Any fire, including the open type of electric radiator, even at some distance from the patient, is a source of danger, especially in open administrations, as the heavy ether vapour falls to the floor and spreads across it in a wave which may ignite with a flash at any moment.

Another disadvantage of ether is its tendency to irritate oral and respiratory mucous membranes. One effect of this is profuse salivation and the formation of mucus, but this can generally be counteracted by

the previous administration of atropine in full doses a step that should never be omitted. Possibly as the result of mucous exudation in the lung passages there is also some liability to bronchitis and even pneumonia as a post operative complication, but these conditions are little, if at all, more common after ether than after chloroform or even various forms of local anæsthesia. They are most often seen after abdominal and especially upper abdominal operations, and are probably due rather to the congestion following the reluctance of the patient to ventilate the bases of the lungs adequately than to the anæsthetic used. It is probable then that provided the excessive formation of mucus has been checked by atropine ether has little or no bad effect upon healthy lung tissue. When, however the lungs are already diseased and the seat of bronchitis emphysema or the like the case is different, and ether should be used very sparingly or omitted altogether. In cases of pulmonary tuberculosis it is absolutely contra indicated.

It is not unusual in the early stages of ether anæsthesia for the patient to develop in one or more limbs or even the whole body, clonic movements usually known as ether tremor. These movements may be very inconvenient and are often caused or exaggerated by placing a limb in a strained position. Fortunately they usually pass off as the anæsthesia progresses but it is not wise to press the dosage unduly. These tremors never lead to a serious result and are in a very different category from those known as late ether convulsions, which occur at a later stage, and usually begin with fine movements in the small muscles round the mouth or eye and spread thence until they develop into epileptiform convulsions of the whole body. They are fortunately very rare and many anæsthetists of experience have never seen them. In spite of many theories, no adequate explanation has yet been given. The condition is a very serious one as death not infrequently follows. The only treatment that can be advised is to remove the anæsthetic at once, to administer oxygen and carbon dioxide, and to avoid resorting to chloroform, which has proved fatal in several cases.

Ether can be administered in many ways. By inhalation through the mouth (closed and open methods), by insufflation into the trachea, by the rectum, or even by intravenous injection dissolved in salt solution. Each of these methods must be separately considered.

1. Closed Ether is best administered by means of some form of Clover's inhaler, a simple pattern of which is illustrated in Fig 894. It consists of a face-piece, a rubber bag and between them a spherical ether reservoir, through which passes the airway connecting the face-piece and bag. It is possible to rotate the ether chamber on the face

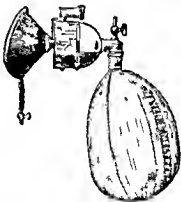


FIG 894—CLOVER'S ETHER INHALER

piece and air tube, and this by a suitable arrangement of diaphragm and slots opens up the ether chamber and permits the patient's breath in a varying degree to pass over the surface of the ether, thereby regulating the dose. An indicator on the apparatus shows what proportion of vapour is being administered. In practice the face-piece is applied with the indicator at '0,' and after a few breaths the ether is gradually turned on, the reservoir being rotated very slightly every third or fourth breath until the mark '2' is reached, by which time the patient should be fairly well under the anæsthetic. As the patient is receiving no air or oxygen during this manœuvre, it is necessary from time to time slightly to raise the face-piece at the commencement of inspiration and replace it just before expiration begins, so as to ensure the introduction of a breath of nearly fresh air into the bag, which should be kept about three-quarters distended. The intervals at which breaths are given will be determined by the colour of the patient, which should never be allowed to become dusky. As the operation proceeds, it is usually possible to reduce the dosage by turning the reservoir back



FIG. 893.—BELLAMY GARDNER'S OPEN ETHER DROPPER AND MASK.

towards the '1' mark. After some ten or twenty minutes the ether in the reservoir becomes exhausted and needs replenishment, while this is being done the apparatus must be removed from the patient's face. Whenever ether has to be poured into the reservoir, the greatest care must be taken that chloroform is not introduced in error. The mistake is easily made, and unless quickly recognized will probably lead to a fatality.

2 For operations of longer duration, the open ether administration is usually preferred. It has the advantage that in addition to the simplicity of the apparatus required, the air-supply of the patient is almost unrestricted throughout. On the other hand, it is not quite easy to keep the patient adequately anæsthetized, and it is very extravagant in the amount of ether used. This does not mean that the patient actually inhales and absorbs more ether than in the closed method. It is rather that large quantities of the ether poured into the mask are never inhaled, but escape into the air of the operating room, to the discomfort of the anæsthetist, the surgeon, and others. The only apparatus required consists of a drop-bottle and some form of wire

mask with a suitable covering. In order to ensure that the patient shall receive a vapour of adequate strength the covering of the mask must be thick *e.g.* eight to ten thicknesses of gauze or a fairly stout piece of flannel. Even then it is desirable to limit the area through which the respirations pass and this can be effected by covering the face and mask with a piece of gamgee tissue in which a small hole is cut through which alone the respirations pass, and through which also the ether is dropped on the mask. Convenient forms of dropper and mask are those shown in Fig 896. The writer finds it more satisfactory however to cover the wire mask with a single layer of thick flannel the free edge of which is tucked up inside. This is then tightly bound round with a gauze bandage which is made to overlap the rim and act as a protection to the face and also allows only a small central portion of the flannel to remain uncovered (Fig 897). The respirations will pass almost entirely through this uncovered area which is kept moistened with ether and the greater part of the face is left open to observation. A mask thus prepared is applied to the face and at first merely a small drop of ether is allowed to fall on it. As soon as the patient has become somewhat accustomed to this a further supply is added and the sequence is continued until the patient is anæsthetized. If the amount of ether is increased too rapidly the result will be coughing holding of the breath and struggling. If on the other hand progress is unduly delayed the time taken to produce anæsthesia will be very long and owing to the exaggeration of the excitement stage, the interval will be an unpleasant one for all concerned. Even in skilled hands the induction is never rapid and at the best is always unpleasant to the patient if practicable it is far better and quicker to induce by a closed method and to change over to the open mask when the patient is unconscious.



FIG 896—OPEN ETHER MASK WITH GAUZE ETC. IN POSITION

(From Hadfield's Practical Anæsthetics)

If initial troubles due to the irritation of the vapour have been avoided or overcome the further progress of the anæsthesia should be uneventful. The respirations should become deeper and more frequent and finally automatic in character. In many patients the automatic rhythm is at more or less regular intervals interrupted by single respirations of a much deeper character, these long ether breaths usually indicate an anæsthesia which is adequate but not too deep. Apart from even the alkaloids used, the behaviour of the pupils under ether is variable. They cease to react to light as anæsthesia deepens and are usually about half dilated, they may, however remain small throughout. Even a widely dilated pupil need cause no anxiety so long as respiration, colour, and pulse remain satisfactory. The blood pressure is a little raised at first, and later falls to about the normal and the colour and

pulse correspond. As the operation proceeds and especially if there is any shock or the dosage of ether has not been progressively diminished the respirations will become shallower and less automatic the blood pressure falls and the colour becomes pale or dusky. If steps are not taken to remedy this the breathing will cease altogether but fortunately there will always be a definite interval before the heart follows suit. Artificial respiration will restore matters if not unduly delayed and the operation can be continued but no more ether must be given till the breathing is re-established and even then with great caution.

To avoid the irritating effects caused by the inhalation of ether it is very usual to induce anaesthesia with nitrous oxide or ethyl chloride and then to change over to ether but a better method is a combined induction. With the Clover's inhaler a tube from a nitrous oxide cylinder can be attached to the tap which leads into the bag and a slow stream of gas allowed to run into it. After a few breaths the patient's pharyngeal reflexes will become less sensitive and the ether can be turned on by small but progressively increasing steps and anaesthesia thus produced without a single cough or any interference with the breathing. As soon as the patient is unconscious the nitrous oxide is turned off *at the cylinder* the tube disconnected and the tap turned. A very similar proceeding can be adopted with ethyl chloride. Immediately before the face-piece is applied some 2 to 5 c.c. of the liquid are injected into the bag through the same tap which is then turned off. After a few breaths the ether can be turned on again as before but usually rather more rapidly. If desired a little more ethyl chloride can be added later but this is seldom necessary.

3. **Warm Ether Vapour**—The pulmonary complications which may follow ether anaesthesia have long been partly attributed to the chilling effect of the cold ether vapour upon the lung alveoli. To counteract this various methods have been devised of warming the vapour before delivering it to the patient. This is by no means easy for if any length of tubing is allowed to intervene between the heating medium and the patient the vapour is found to have lost most of its warmth before it is inhaled. Also it is possible that the irritation is not so much due to the coldness of the vapour as to some inherent quality which is not diminished but may be even increased by warming it. Nevertheless many consider that it is safer to employ warm ether vapour. This is best administered by means of the Shipway's warm ether (chloroform) apparatus illustrated in Fig. 897. It consists of two bottles of the nature of Wolf's bottles containing ether and if desired chloroform. By means of a hand or foot bellows air (or oxygen from a cylinder) is blown through the contents of either or both bottles. The resulting vapour passes through a metal U tube immersed in hot water contained in the adjoining thermos flask. The temperature of this water is shown by the thermometer and is usually kept at about 120° F. the water being replaced by fresh from time to time as required. From the flask the vapour is conveyed to any suitable form of mask on the patient's face by as short a length of rubber tubing as possible. On the top of the other bottle is a three way tap so arranged that the air

from the bellows can be made to pass direct to the thermos or through the ether or the chloroform or both. The whole is held together by a metal container and the portion of this which surrounds the ether bottle can be filled with hot water to prevent freezing. Owing presumably to the irritating quality of the warm ether vapour Shipway himself recommends an induction by some other method or with chloroform through the apparatus and only changes over to the warm ether vapour after consciousness has been lost.

4 **Endotracheal Ether**—This method consists of introducing the anæsthetic vapour into the trachea below the larynx through a suitable tube and so avoiding all obstruction to the airway by the tongue glottis or vocal cords. It was first introduced to facilitate many operations of thoracic surgery. The older practice was to pass a semi

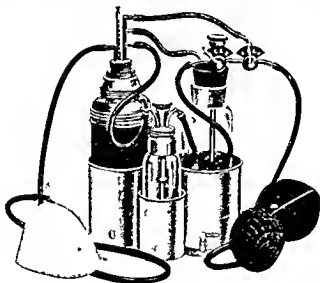


FIG 897—SHIPWAY'S WARM ETHER (CHLOROFORM) APPARATUS

rigid special catheter of suitable size between the vocal cords and push it on until the free end reached the vicinity of the bifurcation of the trachea. A mark on the catheter should indicate when this point has been reached. The most difficult part of the method is the introduction of this endotracheal catheter which should always be undertaken if possible with a direct vision laryngoscope. The best instrument for this purpose is that devised by Magill (Fig 898) which contains in the handle both battery and rheostat. It is first necessary to induce anæsthesia by any suitable method and no attempt should be made to pass the catheter until the anæsthesia is deep. It is true that the expert may be successful with quite light anæsthesia but the less practised the operator the deeper should it be. The patient's head held rigidly in the middle line is slightly extended but not too much so. The laryngoscope is passed back between the tongue and the

palate until the epiglottis is reached and hooked forward. A view of the inside of the larynx should then be obtained, and the vocal cords seen moving rhythmically with respiration. A catheter of the selected size, suitably lubricated, is then rapidly passed down the groove of the instrument and between the cords at the moment they are most widely separated. The catheter is gently pushed further down until the mark indicates that it has reached the desired point, and the laryngoscope is then withdrawn. The whole operation should be simply and easily performed, but it may be very difficult in cases of deformed jaws and teeth, or when the larynx is full of secretion. No force must be employed, since rough or blind pushing may cause permanent injury to the vocal cords. The catheter having been correctly introduced thus its free end is attached by strapping to the patient's face or forehead, so as to prevent accidental withdrawal, and then connected with a rubber tube, through which the ether vapour is passing. This vapour may be obtained from a Shipway's

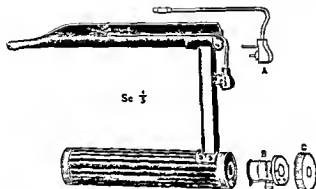


FIG 898 —MAGILL'S LARYNGOSCOPE

apparatus connected with either a bellows or nitrous oxide and oxygen cylinders. Some anaesthetists prefer to use an electric pump which drives air, suitably warmed or not as desired, through ether or chloroform bottles or both. Perhaps the most usual method is to make use of a nitrous oxide and oxygen apparatus, such as that illustrated in Fig 897. Whatever the actual form of apparatus employed, it should be fitted with two indispensable features. The first is some form of spring or mercury manometer to indicate the pressure at which the gases are being delivered, this will vary between about 5 and 25 mm of mercury, according to the size of the catheter, the depth of the anaesthesia required, and the extent to which it is desired to expand the lung or limit the movements of natural respiration. The other essential is some form of automatic or rapidly operated 'blow off' which will enable the pressure to be released at once if necessary.

At first the ether vapour is apt to cause some coughing movements, but these quickly subside, and can be more rapidly abolished by the

very careful addition of a small proportion of chloroform vapour. The patient soon settles down, and the anæsthesia, which should not be very deep, runs an uneventful course. If necessary, the movements of natural respiration can be almost entirely abolished and the patient's pink colour maintained by the use of a suitable proportion of oxygen, but except in special cases it is better to preserve respiratory movements, though their amplitude and excursions may be diminished. It must be remembered that the circulatory mechanism depends largely on the movements of respiration and if these are abolished or diminished the heart's action may be embarrassed.

Although introduced for use in thoracic surgery, endotracheal anæsthesia is now employed in a much wider field and some administrators use little else. In the surgery of the head and neck, it enables the anæsthetist to be entirely out of the way of the operator, and in mouth, nose and throat cases, the maintenance of an adequate endotracheal pressure prevents blood and other fluids from passing down the trachea into the lungs. Operations on the upper abdomen are also facilitated owing to the quietude of the viscera, due to the diminished respiratory excursions. In thyroid surgery the method has great advantages, and when once the tube has been introduced there is little danger of accident from pressure on the trachea, but unfortunately in the most dangerous thyroid cases—the toxic goitres—the perilous period of anæsthesia is that of induction, and the present method does nothing to diminish it.

The technique thus briefly described has the advantage that it enables pulmonary ventilation to be maintained when one or even both pleuræ are opened. For the majority of the operations for which endotracheal anæsthesia is now used such positive pressure in the lungs is not required, and may even be disadvantageous. It is therefore more usual to employ the Magill low pressure system. For this purpose the apparatus used is that illustrated in Fig 899. It will be noticed that there is a rebreathing bag, but that this is placed at some distance from the face piece with which it is connected by some 3½ feet of concertina breathing tube. In practice the bag is attached directly to any suitable gas-oxygen ether apparatus, and near the junction is a lever, by the use of which the bag can be entirely cut out of the system. Close to the face piece is an expiratory valve the excursions of which can be controlled by a screw which, when screwed home, will close it entirely. Thus, with the bag cut out and the valve closed, the pressure obtainable is limited only by the elasticity of the tubing. Used in

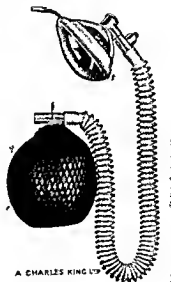


FIG 899—DR MAGILL'S ATTACHMENT FOR CONTINUOUS FLOW APPARATUS

this way the apparatus is almost as efficient for high-pressure work as that already described. When however, as is usually the case, both bag and valve are open, respiration is carried on at about normal pressures. The requisite depth of anaesthesia having been attained in this manner, the face piece is removed and one of the specially made curved india rubber endotracheal tubes is rapidly passed through the larynx. These tubes are less rigid and of much wider bore than the catheters previously mentioned, and they are moulded so as to be slightly curved. It is usually best to select the widest tube that can be passed easily. Very frequently the intubation can be carried out blindly through the nose. The patient's head being slightly extended on the neck the selected tube well lubricated, is passed back through one nostril with its concavity forward. This should bring the bevelled free end of the tube above and through the glottis, and with a further gentle push, at the moment of inspiration, it should pass between the vocal cords into the trachea. The passage of air in and out of the external end of the tube will assure the anaesthetist that the manoeuvre has been carried out successfully. Suitable connections are supplied to attach the tube to the apparatus in place of the face piece and the respiratory excursions of the bag will show that everything is correctly in position. Unless the anaesthesia is very deep there may be some breath holding or coughing for a few moments, but this will soon give place to quiet, automatic respiration. If desired the pharynx round the tube may now be carefully packed with gauze so as to confine both inspiration and expiration to the tube, and, in mouth cases, to prevent the passage of blood into the larynx. Doing so also reduces the amount of anaesthetic required. All that is now needed is to so adjust the flow of gases and the spring of the expiratory valve as to allow the patient to breathe in and out of the apparatus at about normal pressures. Should in emergency increased pressure be required it can be rapidly obtained, as indicated above.

This blind method of intubation is usually quite easy, although it requires a little practice. In other cases it may prove very difficult or even impossible and thus is naturally the case in patients with nasal deformities. The method is equally suitable for such cases, the only difference being that the nasal route is avoided and the same tube is passed through the mouth by direct vision with a laryngoscope as already described. In fact whether the direct or the indirect method is used largely depends on the preference of the anaesthetist and the nature of the operation. A third alternative is to pass the tube into the pharynx through the nose and then to introduce the laryngoscope through the mouth. The free end of the tube is thus seen hanging in the pharynx is grasped by special forceps and directed through the vocal cords by direct vision.

Lastly it is well to remember that the passage of endotracheal tubes of whatever kind may be facilitated by two procedures. One is to make use of sufficient CO_2 during induction to cause deep inspirations with correspondingly wide separation of the vocal cords. The other is to spray the nose pharynx and larynx with a solution of cocaine immediately before induction. In view of the fact that some patients

are abnormally sensitive to cocaine poisoning this procedure is not entirely free from danger

5 Rectal Ether—A very satisfactory anæsthesia can be obtained by introducing a suitable dose of ether into the rectum, whence it is quickly absorbed and subsequently excreted chiefly through the lungs. Formerly the vapour was derived from a suitably arranged bottle of ether immersed in water sufficiently hot to vaporize it but, unfortunately, the rectal mucosa tolerates the irritating gas with difficulty, and a serious attack of proctitis or colitis may possibly be induced. A method which is practically free from these complications is to introduce well up into the rectum liquid ether mixed with olive oil, perhaps combined with a dose of paraldehyde or chloroform. The dose will vary with the physique of the patient and the depth of anæsthesia required. The formula ether 2 to 5 ounces, olive oil 2 to 4 ounces, paraldehyde 2 to 4 drachms will give an idea of a suitable dosage. The bowel must be first emptied by an aperient, followed by an enema. An hour before the operation a full dose of morphine, atropine, and scopolamine is administered, and as soon as this begins to act the patient is placed on his left side with a pillow under the buttock, and a firm walled rubber catheter is introduced as far as possible up the rectum without coiling. The mixture is then run in quite slowly so as to ensure its retention, the funnel is removed and a clip placed on the end of the catheter, which is left in position. The patient will become unconscious and lightly anæsthetic in ten to twenty minutes, and can then be quickly moved from bed to the operating theatre. If the anæsthesia is not quite deep enough, a little extra ether can be administered by inhalation, or a similar effect can be obtained by causing the patient to rebreathe into a bag. Naturally the method is well adapted to operations about the head and neck which do not require a deep anæsthesia for the excision of toxic goitres, in which fatal syncope from fright is not unknown, it is especially useful as the patient goes quietly to sleep in his bed and knows nothing of the preparations for operation. If desired, the thyroid may even be 'stolen' by going through a similar performance of hypodermic injection (of water) and some form of rectal lavage under the guise of treatment for several days beforehand, and only resorting to the true procedure on the day of operation.

At the end of the operation it is usual to wash out the rectum through the catheter, which is then withdrawn, but even when the anæsthesia has been quite light, the patient usually sleeps for some hours, during the whole of which time he should be under observation, as the respirations may become shallow or even obstructed.

Chloroform, CHCl_3 —Although it must be admitted that chloroform is less safe than ether and other anæsthetics, it still remains one of the most valuable agents we possess. Possibly owing to its potency, it is the easiest anæsthetic to administer and requires only the simplest apparatus, and for this reason it is especially popular with those possessing little skill and experience—that is, with those least qualified to recognize and combat its dangers. In the hands of a really skilled anæsthetist, however, chloroform is little more dangerous than ether. The fact that other anæsthetics are usually preferred naturally diminishes

the number of cases in which chloroform is used, and consequently the medical student has few opportunities of seeing its administration or himself undertaking it under skilled supervision. Among the advantages of chloroform may be mentioned the simplicity of its administration, involving the use of practically no apparatus, the non-inflammability of its vapour, the absence of irritation of the respiratory mucous membranes, and the duration of the anæsthesia, which allows the performance of short operations after the anæsthetic has been withdrawn.

There is much conflicting evidence as to whether chloroform is a direct poison to the cardiac muscle or only acts upon it indirectly through the respiratory and vaso-motor centres. Without attempting to discuss the two views, the anæsthetist is advised for purposes of practice, to treat chloroform as a cardiac poison. Although such a position may ultimately prove to be a false one, it is an error on the side of safety.

Whatever the cause, the administration of chloroform leads to a fall of blood pressure, and this fall becomes more marked as the vapour increases in strength, and especially if the strength is increased rapidly. From this fact arise two indications. First the administration should be commenced with a very weak vapour, the strength of which should be progressively, but not too slowly, increased to the maximum necessary, secondly, in order that the fall in blood pressure may not unnecessarily deplete the circulation in the cerebral centres, the patient should always be kept in the recumbent position. Only in the most exceptional circumstances should chloroform be administered to a patient in the sitting posture, and it is equally important to insist that while under chloroform the patient shall not be moved unnecessarily, or even momentarily placed in any position far removed from the horizontal.

Another important point to keep in mind is the close interdependence between the safe strength of chloroform vapour and the colour of the patient. A percentage which is not only safe, but correct, for a patient whose blood is well oxygenated rapidly becomes an overdose if there is any cyanosis. At the slightest sign of blueness, not only must immediate steps be taken to introduce more oxygen into the blood, but chloroform must be withdrawn at once, so as to remove what has been well called the *relative overdose*. Should respiration cease before the natural colour has been re-established, artificial respiration must be commenced immediately, so as to expel from the lungs the heavy chloroform vapour already there, which will continue to be absorbed after the removal of the mask unless expelled by voluntary or artificial expiratory efforts.

A similar effect of relative overdose will follow if the anæsthetist, neglecting the law of diminishing resistance, continues to administer the same dosage throughout a long and exhausting operation. In such a case the percentage of anæsthetic vapour must be gradually decreased, and should the resistance of the patient be suddenly reduced by shock, hæmorrhage or any other cause, it will be well to withdraw the anæsthetic altogether for a time.

Fortunately in most cases of overdose, whether relative or absolute, the first sign of danger is respiratory failure, the heart continuing to

beat for some minutes. Should this happen, immediate withdrawal of the anæsthetic, together with prompt measures to restore the respiration, will usually avert catastrophe. Sometimes, unfortunately, the overdose results in what has been, perhaps inaccurately, termed **primary cardiac failure**. The patient suddenly becomes grey or dusky, the pupils dilate, the skin is cold and clammy, the pulse cannot be felt, and soon the respiration ceases, possibly after a few gasps. The condition is extremely serious, and all the usual methods of resuscitation must be commenced at once. If they are not immediately successful, cardiac massage must be applied without delay. This condition may arise during the course of an operation from a simple overdose, but is much more likely to develop at an early stage of the administration. Possibly during induction a still semi-conscious patient is given too strong a vapour, which causes breath holding. This may be followed by movements and later by struggling which in the absence of respiration cause a deepening cyanosis. After a few seconds the deoxygenated respiratory centre can resist no longer, and the patient is compelled to take one or more deep breaths, which carry into the lung still more of the chloroform vapour, the excessive strength of which was the cause of the trouble. If the anæsthetist has not recognized his error and continues to push the chloroform, the danger will be increased. The strong vapour is carried by the pulmonary veins and the coronary arteries direct to the cardiac muscle. Owing to the cyanosis this muscle is more than usually sensitive to its poisonous action, and primary cardiac failure follows.

Another cause of the same alarming accident is the fact that chloroform vapour, especially when quite weak, acts as an irritant to the cardiac muscle, and is liable to produce ventricular fibrillation in the presence of any excess of adrenalin in the blood. The adrenalin may have been introduced artificially for its hæmostatic action, but in any quantity sufficient to be dangerous it is more likely to be autogenous, and may be due to pain and fright, which it is now known cause large quantities of adrenalin to be poured into the blood stream. In either case primary cardiac failure may result from the association of fear with an anæsthesia which is not sufficiently deep. It is therefore essential, while not pushing the percentage unduly, to increase it steadily during induction in a progressive manner, so as to pass over the dangerous interval as quickly as possible. Further, under chloroform, the patient must not be moved, and still less must any painful or alarming manipulation be allowed, until a condition of definite surgical anæsthesia has been reached and the danger-point passed. It has been said with some truth that fatalities from chloroform are as frequently due to an underdose as to an overdose.

The administration of chloroform is best carried out by some entirely open method. The correct maximum strength of chloroform vapour has been found by experiment to be 2 per cent, and in order to secure this various forms of apparatus have been devised, of which that of Vernon Harcourt is perhaps the best. It is, however, seldom used in spite of its accuracy, since it requires considerable attention which would better be devoted to the condition of the patient, and also not

uncommonly, the maximum 2 per cent is not sufficient to secure the muscular relaxation required by the surgeon, in fact, an addition has been made to the instrument to enable the strength of the vapour to be increased to 2.5 or even 3 per cent.

Chloroform is usually administered from a suitable drop-bottle upon some such metal mask as the 'Schummelbusch,' covered with a single layer of lint, flannel, or gauze. A small drop of chloroform moistens the mask, which is held a few inches from the patient's face and is then gradually lowered to it. A slightly larger drop is then applied, and then other and greater drops progressively added every twenty or thirty seconds until anæsthesia is attained. Even a mask is unnecessary as a piece of doubled lint cut into the shape of a shield about $5\frac{1}{2}$ inches each way ('Bart's lint') is equally effective. The lint is so held as to form a cone. Chloroform is dropped on the upper side, and the cone is then reversed so as to bring the moistened surface over the mouth and nose of the patient, the procedure being repeated with larger and larger drops, the lint being reversed each time. Care must be taken that the lint wetted with chloroform lies only lightly on the face. Any pressure will cause a burn.

Junker's Chloroform Inhaler.—For operations upon the nose and throat chloroform is a particularly suitable anæsthetic, owing partly to the duration of unconsciousness after its withdrawal and partly to its non-inflammability, which allows of the safe use of the cautery or diathermy not infrequently required in these cases. For quite short operations it will only be needful to induce a reasonably deep anæsthesia, and resign the patient to the surgeon. For longer operations it will be necessary to maintain the anæsthesia, and for this purpose the mask or lint described above is obviously unsuitable. In these cases resort is had to a Junker's inhaler in some form or other. This is essentially composed of a narrow chloroform bottle fitted with a stopper pierced by two metal tubes. One of these tubes projects below the surface of the chloroform while its outer end is connected by rubber tubing with a hand or foot bellows. The shorter tube, which only just pierces the stopper, conveys the chloroform vapour produced by the action of the bellows through a suitable length of tubing to a metal pipe or other means by which it can be conveyed to the pharynx through the mouth or nose. The amount of chloroform vapour delivered can be roughly gauged by the strokes of the bellows, and in this way, anæsthesia having been induced in the ordinary way, the patient can be kept under while the surgeon performs his manipulations undisturbed. It is well to remember that it is wise to induce a fairly deep anæsthesia before resorting to the Junker, as although the patient may be kept under by its use it is not a very efficient instrument for deepening an anæsthesia which is too light. Although simple, the apparatus has unfortunately been the cause of quite a number of fatalities, nearly always due to carelessness in its assembly. Should the bellows be attached to the wrong tube the slightest pressure will result in the ejection of liquid chloroform into the pharynx. The burning fluid reaching the larynx causes immediate spasm, and usually a fatal result. A similar catastrophe may follow if the Junker bottle is not kept vertical, as when

it approaches the horizontal position, liquid, instead of gaseous chloroform, can escape from the exit tube. In the model shown in Fig. 900, the former accident is rendered almost impossible by the small ball valve placed at the end of the longer tube. Whatever form is employed, the anæsthetist must never use the apparatus on a patient until he has satisfied himself that it is working properly.

It is now very usual to replace the bellows by a stream of oxygen (with or without nitrous oxide) from a cylinder which not only frees one of the anæsthetist's hands for other purposes, but also helps to counteract any cyanosis due to narrowing of the airway by an accumulation of blood or other fluid. Almost any gas oxygen apparatus (fitted with a chloroform bottle) can be conveniently used in place of the Junker.

A C E. and Similar Mixtures.—The so called A C E mixture is made up of one part of alcohol, two of chloroform, and three of ether. The alcohol prevents the decomposition to which mixtures of ether and chloroform are liable, and also has some slight anæsthetic action. This combination was formerly very popular, especially for children. Like all such mixtures of different volatility, it has the disadvantage that its composition is varying from moment to moment. It is usually administered in some form of mask composed of a metal or leather cylinder, with a face-piece, at the upper end of which is placed a sponge moistened with the mixture. With such an inhaler it is difficult to avoid, when first applied, giving a maximum dose, which weakens progressively until it is necessary to replenish it.

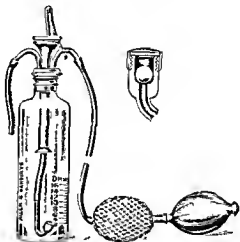


FIG. 900.—JUNKER'S CHLOROFORM INHALER

This is an exact reversal of the better method of commencing with a weak vapour which is gradually increased up to the desired strength. This can be avoided by dropping the A C E upon some form of open mask, which, however, tends to become sodden with the unevaporated alcohol. It was at one time customary to regard A C E as a particularly safe agent, and, in fact, as being almost 'foolproof'. This it certainly is not, and although it may be very useful for the rapid anæsthetization of a series of children, its use demands as much care as other anæsthetics. The more modern view is to regard all such mixtures, not so much as ether fortified by a small but safe dose of chloroform, but rather chloroform weakened by a relatively inert but possibly slightly stimulating diluent.

In addition to A C E there are a number of similar mixtures differing chiefly in the proportion of their constituents. They do not call for

any special remark. In a slightly different category may be placed the much weaker mixtures of chloroform with ether which many anæsthetists are accustomed to use as modified open ether. It may be admitted that mixtures containing one part of chloroform to ten or even twenty of ether help to make the administration of open ether more easy. They are also little more dangerous than pure ether if it is borne in mind that the chloroform owing to its lower volatility is constantly tending to accumulate on the mask. It is perhaps even better if the assistance of a little chloroform is required to give it occasionally for a few moments on a separate mask reverting to pure ether in between.

Ethyl Chloride C_2H_5Cl —Ethyl chloride is a very valuable anæsthetic the possible dangers of which have been exaggerated for if reasonable care is taken in the administration it is little more dangerous than nitrous oxide. At ordinary temperatures ethyl chloride is a mobile liquid which can be volatilized by the warmth of the hand. It is obtainable in metal or glass tubes fitted with a suitable stopcock and can be administered by both open and closed methods. The former is certainly better and safer for children but for adults the latter is more economical and more efficient. Various inhalers are on the market but the bag and face-piece of a Clover's inhaler (the reservoir being laid aside) form an adequate apparatus. Some 2 to 5 c.c. of the liquid are injected into the bag through the tap and the face-piece is at once gently applied if possible at the commencement of an expiration so as partially to distend the bag. The vapour is not unpleasant and if respiration is not impeded consciousness will be lost in three or four breaths. In one or two more the eyeballs become fixed the pupils partially dilated and there is probably some soft stertor. There is no cyanosis even if the face piece has not been lifted but better anæsthesia may be obtained by giving an occasional breath of air and keeping the face piece in position a little longer. If desired an additional dose can be injected when necessary. In the condition described above the anæsthesia is deep and sufficiently lasting to allow of tooth extractions incisions of abscesses the avulsion of nails etc. If there are signs of returning consciousness before the operation is completed a further period of anæsthesia can be obtained by repeating the dose. This may be done quite safely if the following simple rule is observed. When once the patient has been well anæsthetized no more ethyl chloride should be given until the dilated pupil has definitely commenced to contract. With a suitable patient the anæsthesia can be prolonged almost indefinitely by successive doses but such a procedure is not recommended except in emergency. The only danger of ethyl chloride is that of overdose and this is usually due to the inexperience of the anæsthetist who not realizing the potency and rapidity of action of the drug gives an additional dose when the patient is already deeply under. In a similar way the available operative period may be diminished by failure to appreciate the rapidity with which anæsthesia has developed.

The symptoms of overdose are sufficiently alarming. The breathing ceases and the pulse stops probably at the same moment or very shortly after. The chest muscles become rigid so as to render artificial

respiration difficult, or even impossible. Children are best treated by being held vertically by their heels, and adults by such attempts at respiration as can be made.

For the open method the ether mask shown in Fig. 896 is very useful. The child's hand should be controlled as though not really unpleasant, the strange smell is apt to cause snatching at the mask. A few c.c.'s are sprayed inside the mask which is applied immediately to the face. It will probably be necessary to add a little more on the outside of the mask shortly after. The course will be practically identical with that described above, and in a few breaths the child is anæsthetized. If desired the anæsthesia can be continued by the administration of open ether, this is, in fact, one of the best methods of anæsthetizing children for major surgery. For minor surgery the operation may be commenced as soon as a slight stertor is heard, the mask being removed or retained in position according to the nature of the case.

The recovery of consciousness is rapid though there may be a rather longer period of analgesia. The after effects are slight, but more prominent than those of nitrous oxide. There may be some giddiness and nausea, or even vomiting, but any discomfort is relatively transient.

Ethyl chloride anæsthesia does not give good muscular relaxation. It is well borne by children and the aged and for dental extractions in children it is in many ways preferable to nitrous oxide, as a considerably longer anæsthesia is obtainable without any tendency to cyanosis.

Ethylene, (C_2H_4)—This is an anæsthetic gas much resembling nitrous oxide in its general action. The methods and apparatus already described for the latter are also suitable for ethylene. It has the double advantage that it can and must be combined with a higher percentage of oxygen than nitrous oxide, and it also gives a somewhat better degree of muscular relaxation. A grave drawback is that combined with air or oxygen it forms a highly inflammable and explosive mixture. Another disadvantage is its objectionable odour.

Pre-medication and Basal Anæsthesia—A striking development of modern anæsthesia is the increasing use of a number of substances which, while not themselves anæsthetics, are sufficiently potent to render the patient unconscious or semi-conscious while still in his bed before removal to the operating theatre. In this way much of the mental stress of awaiting the 'zero hour' is avoided and the patient should have no recollection of the induction of anæsthesia, which, however skilfully conducted, can seldom be a pleasant experience. Something of the sort has been done from early days by the use of morphine, scopolamine, omnopon, and other similar drugs, as mentioned on p. 1509. In suitable cases the results so obtained leave little to be desired, but for many others they are not so good, and the use of one of the modern so-called 'basal anæsthetics' is preferable. Another great advantage of successful basal anæsthesia is that it usually appreciably diminishes the amount of general anæsthetic required for any particular purpose. Thus under its influence many operations may be conducted under gas and oxygen alone which would otherwise require the use of ether, or, if ether has to be added, the amount called for is far less than would otherwise have been the

case. Indeed in specially susceptible patients it may be found that safe basal anaesthesia is adequate for the performance of minor operations. Among the more popular basal anaesthetics are

Avertin (Tribrom-ethyl Alcohol)—This is a proprietary agent designed for rectal use. In full doses it will give surgical anaesthesia but there is serious danger of respiratory failure. In smaller safe doses it is an admirable hypnotic and is much used in combination with local or light general anaesthesia. A safe dose is up to 0.2 gramme of the patient's body weight. Before injection the solution must be tested to ensure that no acid decomposition has occurred.

Paraldehyde is also largely used by rectal injection. It is almost if not quite as efficient as avertin and certainly safer. It is especially serviceable for the nervous child and can be used in combination with olive oil when its absorption is rather slow or for more rapid action dissolved in nine or ten times its bulk in normal saline solution. A full dose is 1 drachm for each stone of the patient's body weight.

The Barbiturates—A large number of derivatives of barbituric acid have hypnotic properties. Those most used as basal anaesthetics are sodium amytal, pemoction, and nembutal, of which the last seems the most popular. It can be given intravenously the appropriate solution being injected very slowly until the patient just falls asleep. More conveniently but with less certainty of action it may be administered by the mouth. It is put up in capsules each containing $1\frac{1}{4}$ grains. Two or even three of these capsules swallowed about an hour before operation will give satisfactory results with most patients. The addition of a small dose of morphia (gr. $\frac{1}{4}$ hypodermically) is an advantage.

Evipan Sodium—This is another derivative of barbituric acid which differs from those mentioned above in that with safe doses it does produce a true anaesthesia adequate for almost any operation of short duration. It is however especially suited for brief minor operations such as the manipulation of joints, opening abscesses, the extraction of teeth or even for painful dressings. Evipan is supplied in a very convenient packing so that a sterile 10 c.c. syringe can be quickly filled with solution of the correct strength. This is injected into the patient's vein. Usually when 2 to 3 c.c. have been so injected the patient will cease the counting he has been instructed to continue and will be found to be asleep. The actual amount of the solution required to reach this stage is noted and for quite light and brief anaesthesia as much again is injected. For more prolonged and deeper anaesthesia a total of three times the first amount will probably be required. No really satisfactory scale of dosage by body weight or otherwise has been discovered as there are considerable variations in the susceptibility of different patients. That indicated above will be found as good as any other. It is well to remember that jaw and tongue muscles are specially apt to relax completely at a very early stage and so unless adequate steps are taken to prevent it the airway may be seriously obstructed even before the injection is completed. Recovery of consciousness is usually rapid and attended by few if any unpleasant sensations. Many patients are or appear to be in a fit state to return home unaccompanied half an hour after they wake up but the desira-

bility of permitting this is questionable. In minimal doses evipan can also be used as a basal anæsthetic before general anæsthesia. Employed thus it is perhaps more efficient than the other barbiturates and, owing to its rapid elimination, is well suited for cases in which prolonged post anæsthetic narcosis is undesirable.

Carbonic Acid Gas, as being the natural and the most efficient respiratory stimulant, is of great service to the anæsthetist. A maximum of 5 per cent. in oxygen will shorten the induction, and also at the end of an operation, by ventilating the lungs will rapidly eliminate the anæsthetic, and so hasten the recovery of consciousness and lessen post anæsthetic complications. It will also combat respiratory failure and counteract shock. In higher percentages it acts not only as an asphyxiant but also as a poison, and therefore cylinders containing it should always be distinctively marked. Neglect of this precaution has caused a fatal accident.

Local Anæsthesia.

Under this name are grouped a number of methods by which operation pain is abolished without necessarily interfering with the consciousness of the patient. Even when, as is often the case, it is combined with a light general anæsthesia, the latter is of only secondary importance, and is given to avoid anxiety, etc.

The many methods of local anæsthesia may be divided into two groups. In the first, the true local or infiltration anæsthesia, the actual nerve endings in the part to be operated upon are insensitized by being surrounded by a suitable solution of some analgesic drug. In the second, regional anæsthesia, the same effect is obtained by exposing to the action of a similar solution the trunks of the sensory nerves supplying the part, and so, while leaving the nerve endings unchanged, blocking the path of pain impulses from them to the central nervous system. This second method has an advantage over infiltration in that it presents to the surgeon an operation area in its natural condition, and not one rendered œdematous by the presence of large quantities of solution. On the other hand, its successful performance demands detailed anatomical and neurological knowledge, and also involves a technique which differs greatly in different parts of the body. With the exception of the so called spinal and splanchnic methods, no attempt is made here to describe the details of such technique.

Freezing.—This is the simplest of all forms of local analgesia, and is very useful for quite minor operations, such as the incision of superficial abscesses. The area to be incised is exposed to the intense cold obtained by the evaporation of an ether spray, or, better still, to that of a fine jet of ethyl chloride. The parts soon become white, hard, and frozen, and can then be incised without pain. For this purpose it is essential to use ethyl chloride in the special 'local' containers, as the tubes used for general anæsthesia have too wide a jet to allow sufficiently rapid evaporation. Freezing is perhaps of more use to the surgeon than to the patient, as although the actual operation is painless, the subsequent process of thawing is decidedly the reverse.

Infiltration Analgesia—Many drugs have been used for this purpose of which cocaine is the most effective unfortunately however, it may be very toxic and its general use is also contra indicated for other reasons. Consequently it has been almost discarded except for application to mucous membranes etc as described below. The agent which is now in nearly universal use is novocaine, which in proper doses is almost free from poisonous qualities and has also the advantage that its solutions can be sterilized by boiling. For the infiltration of the skin and subjacent structures a 0.25 to 1 per cent solution combined with a small amount of adrenalin can be safely used in considerable quantities. The apparatus required in addition to the solution is limited to a suitable sterilizable syringe with one or more needles of varying shape and length that can be attached to it by a bayonet catch or other similar joint. In the infiltration of large areas considerable time is lost in the continual refilling of the syringe. This can be obviated by the use of an automatically refilling syringe. Embodied in such a syringe is a two way valve with a fine rubber tube leading into a vessel containing the novocaine solution. The withdrawal of the piston fills the barrel with solution which is in turn forced into the tissues as the piston is pressed home. The method of infiltration usually adopted is to commence by raising in the skin over the required area a number of wheals by actual endermic injection of the solution. When a sufficient number of these wheals has been made the needle can be introduced painlessly through them into the deeper tissues. By this means a large area can be rendered analgesic in a fairly short time and the analgesia can be carried to any desired depth or if preferred the lower layers can be treated subsequently after the more superficial ones have been incised.

While extremely useful and successful for infiltration and regional methods novocaine is almost ineffective when applied to unbroken surfaces such as skin and mucous membranes. For the unbroken skin freezing is certainly to be preferred to any other method. For mucous membranes various less toxic substitutes for cocaine have been introduced and may be said to be still on trial. For reliable results the surgeon still has to rely upon cocaine itself. This holds good for such surface applications as the urethra and bladder the eye and nose throat and larynx. For nasal work it is usual to apply a 5 to 10 per cent solution (with adrenalin) on packs of wool or gauze. For the eye a few drops of a 4 per cent solution may be instilled into the conjunctival sac. The throat and larynx can be painted or sprayed. The urethra can be rendered insensitive by the injection of a 4 per cent solution.

In nasal surgery it is not unusual previously to pack the nose with a solution of cocaine even when a general anæsthetic is to be given for the actual operation. If as usual the cocaine is combined with adrenalin it is well to remember the real danger of light chloroform anæsthesia in the presence of added adrenalin which is referred to elsewhere.

Spinal Anæsthesia—Spinal anæsthesia or more accurately analgesia is a very useful method well within the competence of anyone who

has mastered the technique of lumbar puncture. All that is necessary is careful attention to detail. The apparatus consists only of a couple of lumbar puncture needles, a syringe of the 'record' type, and an ampoule of the selected solution. Various drugs can be used. That most in favour when the method was first introduced, and for long afterwards, was stovaine. At the present time novocaine is more popular. It can be used in simple solution in saline, or even dissolved in cerebro spinal fluid. There are also available quite a number of novocaine preparations in which the drug is combined with a variety of other substances designed to combat any ill effects, or otherwise to control its action. Each of these has its own trade name and each requires its own particular method. It is impossible to describe here the technique of the administration of even the more popular of these solutions, nor is it necessary, as the makers supply full and reliable instructions. The differences in method depend almost entirely on whether the particular solution has a specific gravity greater than, equal to, or less than, that of normal cerebro spinal fluid. This is conveniently expressed by describing it as hyper-, iso-, or hypo-baric. Although, as mentioned above, stovaine is less popular than formerly, the writer still finds it most useful and reliable. It has been selected for more detailed description because the particulars so given can be applied, with slight modifications, to any of the other lighter or heavier solutions. Stovaine can be purchased in ampoules containing a sterilized solution ready for use. There are a number of minor varieties, but two distinct forms which must be carefully distinguished. The heavy solution is hyper-baric, and contains 5 per cent stovaine combined with glucose, and each ampoule holds 2 c.c. When introduced into the thecal canal, the solution, owing to its high specific gravity, behaves like a marble in a rigid tube, and the position it assumes can be varied by tilting the patient's spine, thereby to some extent adjusting the level of the analgesia. With this solution the head and shoulders must be kept raised on pillows, in order to prevent the drug from acting upon the roots of the phrenic and other respiratory nerves or from reaching the higher centres in the brain. As, however, stovaine becomes 'fixed' in about ten minutes, the position of the patient can be altered at will after this time has elapsed. Spinal analgesia is specially suitable for certain operations requiring the Trendelenburg position, and the disadvantage of the heavy solution is that this position cannot be adopted until some minutes of the available operating time has been wasted. The light solution is designed to be iso-baric or of about the same specific gravity as cerebro-spinal fluid, and so it should mix with that fluid by diffusion alone and be quite unaffected by the action of gravity. It is now stated, no doubt truly, that in actual fact this solution is slightly hyper-baric, but in practice this seems immaterial, as the writer has found, after its use in very many hundreds of cases, that, whatever its specific gravity, it can be relied upon to act as a light solution. It is usually put up in ampoules containing 1 c.c. of 10 per cent solution in normal saline. It should be noticed that it is thus twice the strength of the heavy solution, and so calls for but half the dose. As soon as it has been

introduced into the cerebro-spinal fluid the patient may at once be placed in the Trendelenburg position and the operation commenced. Stovaine like all other agents used for this purpose as it becomes absorbed is liable to produce a definite fall of blood pressure and owing to this fall a raised position of the head is apt to produce faintness. It is therefore wise to operate with the head lowered and so for most purposes a light or iso baric solution is to be preferred.

The lumbar puncture needles and the syringe are carefully sterilized preferably by boiling in plain water free from soda for stovaine is rapidly destroyed by even traces of alkali. The patient is placed sitting acutely bent forward on the edge of the table (the easier position for the operator) or lying on one side with the nose and knees brought as closely together as possible (the position less uncomfortable for the patient). The skin having been suitably purified an imaginary line is drawn connecting the highest points of the iliac crests. This line crosses the spine of the fourth lumbar vertebra and any one of the two or even three intervertebral spaces above this is suitable for the puncture. The skin in the vicinity may be previously infiltrated with novocaine, but this is quite unnecessary. If the needle is sharp and is introduced into the skin by a rapid movement there should be little more pain than that involved in giving the novocaine. The line of the puncture should be central and at right angles to the skin and in the direction of the (unseen) umbilicus. If the spine is well flexed no bony obstruction should be met but the added resistance of the ligamentum subflavum can be appreciated as the needle passes through it. The stylet is then withdrawn and clear cerebro-spinal fluid should flow out. An amount of fluid slightly in excess of that to be introduced is allowed to escape and the syringe previously charged with the stovaine (about 0.6 to 0.8 c.c. of the light solution) is attached to the needle. The plunger is then withdrawn so as to mix the solution with 1 c.c. of cerebro-spinal fluid and the resulting mixture is injected into the thecal canal. If without removing the syringe the plunger is again withdrawn and pushed home it still further diffuses the stovaine solution. The syringe and needle are then withdrawn together and the skin puncture is covered by a piece of adhesive strapping. The patient can at once be prepared for operation and the analgesia should be absolute by the time this has been done. The muscular relaxation also will be far greater than can safely be produced at such an early stage by any form of inhalation anaesthesia. The duration of the analgesia is somewhat variable but a minimum actual operating time of at least forty five minutes should be assured. At the close of this period the patient may complain of soreness and if this is the case it is only necessary to give a sufficient amount of any other anaesthetic to keep him slightly asleep.

Some patients retain a good colour throughout but a certain amount of pallor (due to the lowered blood pressure) is the rule. Fortunately the actual condition of the patient is usually much better than it appears at first sight. The pulse is usually full but often so slow that it may be momentarily missed by an over-anxious observer. Very occasionally dangerous respiratory trouble may appear. This is

certainly not due to an ascending paralysis of the respiratory nerves but to a direct effect on the respiratory centre, the cause of which is unknown. The treatment is the administration of oxygen, combined, if possible, with 5 per cent CO_2 and if necessary the intravenous injection of weak adrenalin solution. A minor but not infrequent trouble is retching or even vomiting which is very disturbing in abdominal operations. It usually occurs about ten minutes after the introduction of the stovaine, and is fortunately of short duration. The administration of oxygen is said to be of benefit.

The definite fall of blood pressure is not usually great but if the pressure is already low the additional fall may lead to a fatality. For cases in which great operative shock is anticipated, spinal anæsthesia is ideal, for it effectually blocks the nervous paths of the shock impulses. For cases which are already 'shocked', the use of spinal analgesia is strongly contra indicated.

This method should never be relied upon with no other anæsthetic at hand, for in rare cases the lumbar puncture may be so difficult as to be impossible. Again, occasionally, although the technique has been carried out faultlessly, no analgesia follows, this is difficult to explain, but may be due to faulty solution.

Spinal analgesia is a great boon to patients who have a dread of losing consciousness, to the majority, however, it presents the defect that they are aware of what is going on. In order to obviate this, the patient may be kept lightly under some general anæsthetic, preferably gas and oxygen, but perhaps a better plan is to induce some form of 'twilight sleep'. A useful routine is as follows. About one hour and a half before the operation a hypodermic injection of $\frac{1}{16}$ grain of scopolamine is given, followed three-quarters of an hour later by a second injection of scopolamine $\frac{1}{16}$ grain, atropine $\frac{1}{16}$ grain, and morphine $\frac{1}{4}$ to $\frac{1}{2}$ grain. The results are somewhat variable, often patients are unconscious of the move to the theatre, and remain asleep throughout, others appear almost unaffected by the drugs and remain fully awake, but even in the latter case it is usually found that a very faint and blurred recollection of the event is retained on the following day. The method is usually more successful with women than men.

The use of spinal analgesia is best confined to operations not extending far above the umbilicus, but if desired the loss of sensation can be carried upwards. For gynecological operations and those upon the rectum and bladder (especially the prostate) the method is almost ideal, and large impacted tumours can be readily and quickly levered out of the pelvis without shock. For suitable operations in patients suffering from diabetes the method is most valuable, as it is far less disturbing to the metabolism than any general anæsthetic.

Percaine.—This is one of the newer local anæsthetics which is now used extensively for spinal analgesia. In chemical composition it differs entirely from the other drugs mentioned, as it is a derivative of quinoline. Although highly toxic, it can be used in such high dilutions that it is probably as safe as novocaine or stovaine. It can be purchased put up in ampoules each containing 20 c.c. of a 1 to 1,500

solution ready for injection. The dose will vary with the level of analgesia required, but will usually be between 12 and 18 c.c. The general technique is that described for stovaine, but, as the solution is lighter than cerebro-spinal fluid the patient should be placed lying on his face (with the buttocks slightly raised) for at least five minutes after the injection has been made. This is to ensure that the solution shall reach the posterior roots. A hypodermic injection of ephedrine (1 to 1½ grains) is usually given at the same time to combat any fall of blood pressure. Another popular form of percaïne is much stronger, being put up in ampoules of 1 to 200 solution. This is a heavy solution, and so must be used with the precautions mentioned for heavy stovaine. It is specially useful for relatively localized operations about the rectum, bladder, or perineum. Percaïne has two distinct advantages over stovaine. The analgesia obtained from it lasts very much longer, and a much higher level of analgesia can be obtained with safety, allowing the performance of all abdominal operations, though a little gas and oxygen may be required to abolish the retching caused by undue traction upon the upper viscera.

Splanchnic Anæsthesia is a special regional method which has been largely used, and with much success, especially in gastric surgery. It depends upon the fact that the stomach, small intestine, omentum, liver, and hilus of the spleen are innervated by the greater and lesser splanchnic nerves, which enter the abdomen by piercing the crura of the diaphragm, and run to the celiac plexus on the loose retro-peritoneal tissue on the sides and front of the bodies of the vertebrae. If these two nerves are suitably 'blocked' by infiltrating this lax tissue with a 5 per cent solution of novocaine with adrenalin, the organs named can be handled painlessly. In addition, it is, of course, necessary to render the abdominal wall and the parietal peritoneum insensitive by local infiltration or regional analgesia of intercostal nerves. One mode of access to the splanchnics is from the back. A long (12 cm.) needle is introduced through the skin of the back at a point below the twelfth rib, and 7 cm. from the middle line. The needle should be directed inwards at an angle of 45° to the skin, and at some depth should impinge upon the body of a vertebra, when it is gently manoeuvred forward to reach the antero-lateral aspect of the vertebra. The piston of an attached syringe is then slightly withdrawn to make sure that no blood enters the syringe. If this is the case, it shows that the point of the needle is not inside any large vessel, and the injection of the novocaine can be performed. The patient is then turned over and the injection repeated on the opposite side. The anterior abdominal wall is now anæsthetized and the operation proceeds. Another method which is perhaps more in favour at the moment is to deal first with the abdominal wall, and then through the open peritoneal cavity to inject the solution directly into the loose tissues mentioned above. This is perhaps quicker, and less difficult and uncertain, but it has the disadvantage that it involves the somewhat painful handling of the abdominal contents before they are anæsthetized. Like all such methods, splanchnic analgesia is in more general use in countries where inhalation is less employed.

CHAPTER XLIX

SURGICAL AFFECTIONS OF THE EAR.

By V E NEGUS MS FRCS

THE Examination of the Ear is carried out by inspecting the external auditory meatus and membrana tympani through a speculum by testing the power of hearing, and by ascertaining whether or not the Eustachian tube is permeable, and the effect on the hearing of inflation through this channel

1 **Visual Inspection** by means of a speculum and frontal mirror In introducing the speculum the auricle is held between the third and fourth fingers of the operator (the left hand being used for the right ear, and *vice versa*) and drawn backwards upwards, and outwards so as to straighten the cartilaginous portions of the meatus The speculum held by the operator's thumb and first finger is then gently inserted and held in position The reflected light illuminates the tympanic membrane, unless the presence of wax epithelial debris, or pus obstructs the view, when they must be removed by cotton wool mops or by

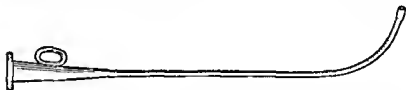


FIG 901—EUSTACHIAN CATHETER

syringing It may be impossible to insert the speculum because of dermatitis or furunculosis The following points are to be noted in the normal membrana tympani (Fig 901) The projection of the short process and handle of the malleus which runs from the centre upwards and forwards, behind this the processus gracilis of the incus and the tendon of the stapedius, and at the upper border Shrapnell's membrane (Fig 904) The motility of the membrane should be considered, as also its colour, whilst the presence of perforations, polypi, or adhesions should be noted

2 **The Investigation of the Hearing** is usually carried out by testing the greatest distance at which the patient can hear the ordinary conversational voice, the whispered voice, or the tick of a watch

Discovery of the cause of deafness is assisted by Rinne's Tuning-Fork Test. A tuning-fork of about 256 double vibrations is placed in contact with the mastoid process, and retained there until the patient can hear it no longer. If now it is placed opposite the external auditory

meatus the sound should again be heard if the middle ear is normal but not if disease of the external meatus or middle ear is present. It may be necessary to employ forks of lower vibration rate for this test if the deafness is slight such as those of 128, 64 or 32 double vibrations per second. Weber's Test consists in placing a vibrating



FIG 902



FIG 903



FIG 904



FIG 905

FIGS 902-905.—APPEARANCE OF THE MEMBRANE IN VARIOUS CIRCUMSTANCES ON EXAMINATION THROUGH A SPECULUM

By permission from Mr Albert A Gray's *Diseases of the Ear* (London: Baillière Tindall and Cox)

Fig 902.—Normal membrane (right side)

Fig 903.—Perforation below and in front of head of malleus (left ear) in acute otitis suppurativa

Fig 904.—Perforation through Shrapnell's membrane in chronic otorrhoea

Fig 905.—Polypi protruding through perforation in membrane

tuning fork in the middle line of the forehead. In cases of pure middle ear disease the sound will appear to be louder in the affected ear than on the healthy side.

3. Perception of high tones is tested with a monochord or with Salter's whistle. Lack of appreciation of high pitches indicates involvement of the cochlea or auditory nerve.

4 **Inflation of the Tympanic Cavity** is required both as a test of the permeability of the Eustachian tube and also as a means of treatment in various conditions. The methods of effecting it are as follows.

Valsalva's Method consists in closing the lips holding the nose and expiring forcibly the air is thereby driven up the Eustachian tubes if they are patent.

In **Poltzer's Method** an indiarubber bag with a teat like end is introduced into one nostril so as to occupy it completely. The other nostril is closed by the surgeon's finger. The patient is instructed to take a sip of water and to hold it in the mouth with closed lips until told to swallow. As he swallows the bag is forcibly compressed and air is thereby driven up the tubes. An auscultating tube may pass from the patient's meatus to the surgeon's ear and various sounds—whistling, bubbling, etc.—may be detected according to the character of the lesion.

The **Eustachian Catheter** (Fig. 901) can be passed into the Eustachian tube and the degree of inflation more accurately controlled. The instrument carefully sterilized is passed with the beak downwards along the inferior meatus of the nose until the posterior pharyngeal wall is reached. As soon as its tip touches the posterior wall of the naso-pharynx the anterior end of the instrument is slightly raised and is withdrawn for about half to three-quarters of an inch until the beak is felt to be in contact with the posterior end of the hard palate. The catheter is then rotated through a quarter of a circle until the beak points directly outwards. It is then pushed a little onwards and is usually felt to slip easily into the opening of the Eustachian tube. (Lambert Luck)



FIG. 906.—ACCESSORY AURICLES IN A CHILD

External Ear—The pinna may be congenitally absent, and even the external meatus closed, a malformation often associated with macrostoma. The external deformity may be rectified by a plastic operation but usually nothing can be done for the lack of hearing, and the surgeon must not be tempted to try and dig out the concealed membrana tympani. More frequently **accessory auricles** are present (Fig. 906) consisting merely of fibro-cartilage covered with fat and skin. Large and prominent ears constitute a very ugly deformity for which operative interference is occasionally required. **Hæmatoma** of the ear is usually due to injury but is occasionally idiopathic in origin especially amongst the insane. The auricle becomes swollen and enlarged and of a bluish-red colour in traumatic cases.

(Fig 906) unless the swelling is punctured and the blood let out, considerable deformity will result from its organization. Eczema, boils, and other inflammatory affections as also sebaceous cysts are met with in the external ear and pinna. Boils or furuncles form in the follicles of the hairs guarding the external auditory meatus. They cause great pain, and may produce deafness through obstruction. If the local inflammation spreads there is swelling behind the ear causing prominence of the auricle making the diagnosis from mastoid abscess difficult. If the auditory meatus be in the slightest degree patent or if a small speculum can be introduced hearing and tuning fork tests will be found almost or quite normal in uncomplicated cases of furunculo is when acute otitis media with or without mastoiditis is present there is marked deafness. Epithelioma may attack the auricle or auditory meatus and may involve the middle ear.



FIG 907—HÆMATOMA
AURIS

Plugs of Cerumen (wax) which become dark and indurated not unfrequently block the meatus leading to more or less complete deafness, this may come on suddenly after bathing owing to the rapid swelling of the plug. If they encroach on the membrana tympani subjective symptoms of giddiness vomiting and rushing noises in the ear may also be caused. On examination with a speculum their presence is readily detected. Treatment consists in washing them away, after previously softening with a solution of sodium bicarbonate. A large syringe with a fine nozzle should be used and a stream of warm normal saline solution injected along the floor or roof of the meatus as it returns the softened masses of wax are washed away. Foreign bodies in the meatus such as buttons or beads are similarly removed if possible, by syringing if this fails a fine pair of forceps or a fine hook may be employed but due care must be taken of the delicate structures behind. Where other plans fail the auricle must be turned forwards and the meatus opened from behind. Exostoses occasionally rise from the bony walls of the meatus they cause deafness by obstruction and may call for a modified mastoid operation. The proximity of the facial nerve must be remembered and the operation should never be lightly undertaken.

Affections of the Middle Ear

Traumatic Rupture of the Tympanic Membrane is due to direct or indirect violence the former includes the introduction of foreign bodies or the ill advised efforts of friends or even of medical practitioners to remove the same the latter causes rupture of the membrane by the sudden compression of the air in the external meatus *e.g.* by boxing

the ear, by loud noises as from explosions or big gun practice, or from diving. The lesion also occurs in some fractures of the middle fossa of the skull. The patient complains of pain and deafness and blood escapes from the meatus but not in any great amount. On inflating the middle ear, as by Valsalva's or Politzer's methods, air can be heard to escape through the opening perhaps with a whistling sound. As a general rule these cases do well the wound cicatrizing and the hearing being fully restored but the surgeon must at first give a guarded opinion as there may be some deeper lesion which does not immediately become apparent. The greatest care must be taken to sterilize the meatus by filling it with 1 in 20 carbolic lotion or tincture of iodine, which is allowed to soak in. A strip of gauze is then gently inserted into the meatus, and an external dressing applied.

Otitis Media.—Inflammation of the middle ear is an exceedingly common affection, and constitutes the great bulk of all ear diseases. It must be remembered that the tympanic cavity is lined by a mucous membrane which is in direct communication through the Eustachian tube with that of the naso-pharynx, and hence the cause is almost invariably an extension of inflammation along the Eustachian tube, and the organisms usually present are the pneumococcus or ordinary pyogenic cocci. The inflammation may be catarrhal or suppurative, acute or chronic.

Acute Inflammation of the Middle Ear is very common in children, being secondary to lesions of the naso-pharynx, such as an ordinary cold, scarlatina, measles etc. particularly if adenoids are present. It is ushered in by severe pain in the ear of a boring persistent character together with deafness and some degree of fever. The pain increases as the secretion accumulates and if the Eustachian tube becomes closed in consequence of the inflammatory hyperæmia of its lining wall, the tympanic membrane bulges outwards into the meatus and finally ruptures (Fig. 903), the pain being at once relieved. The discharge is mucous, or purulent from the first, in the former instance, if infection from the meatus is guarded against, the inflammation may subside, the perforation heal, and no ill result follow. In many instances, however, especially when the child is suffering from measles or if his resisting powers to microbic invasion are low, the catarrhal otitis media is transformed into a suppurative lesion, which may persist as a *chronic otorrhœa* for a lengthy period.

Treatment.—In the first place, the possibility of infection from the external meatus must be guarded against by thorough purification, the external ear is well cleansed, and the meatus is filled with 1 in 20 carbolic lotion, which is allowed to soak in and act for some minutes, or the meatus may be filled with bismuthide of mercury in spirit. An antiseptic dressing is then placed within and over it. The child is kept in a warm room, and his general condition attended to by suitable diet, diaphoretic medicine, and a smart purge. Carbolic acid (5 per cent.) in glycerine, or drops of otalgan instilled into the meatus, may relieve pain, and in adults it may be possible to cocaineize the orifice of the Eustachian tube in the pharynx, thereby relieving the hyperæmia and opening up the tube, and thus giving an exit to the retained

discharge. Pain is often relieved by fomenting the ear or by the application of heat, as in the form of a hot water bottle or a poultice of antiphlogistine.

When the membrane is seen (by speculum) to be bulging it is wise to incise it (*myringotomy*), as a clean cut usually heals better than a ragged perforation. General anesthesia is required and the incision is usually made just behind the handle of the malleus from below upwards. An antiseptic dressing is left in and over the meatus until healing has occurred.

Inflammation may extend into the mastoid cells, giving rise to the condition known as *mastoiditis*. This complication arises in individuals with a cellular type of mastoid process, they constitute 80 per cent of the total, the remainder having a dense or diploetic type of bone.

The mastoid process is a triangular mass of bone lying behind the auditory meatus. It contains a greater or less number of cells lined with mucous membrane which communicate with the antrum, which itself communicates with the posterior part of the tympanic cavity (attic) by means of the aditus. At birth and for some years the antrum is solitary, but later the process begins to develop and may take on two types: (a) The *cellular*, in which the whole bone becomes more or less hollowed out into a spongy mass of cells which may extend back to the occipital bone down to the tip of the mastoid process and in some cases above the auditory meatus (zygomatic cells), or pass forwards under cover of the facial nerve, (b) the *acellular* type, in which but few cells appear, the antrum remaining small, and the bone itself of stony consistency. As a rule the cells lie below and superficial to the antrum, which is more deeply placed in the adult than in the child, the aditus also is relatively larger in the child than in an adult. The cellular mastoid is that in which serious trouble develops in the course of catarrhal or exanthematous infections.

When purulent otitis media extends into the mastoid air cells severe local and general symptoms may result, particularly if the aditus becomes blocked. The patient complains of intense pain in the ear with tenderness on pressure, periosteal thickening and perhaps redness and oedema over the mastoid process. The discharge from the ear often ceases for a time at the commencement of these symptoms, but reappears later. As the case progresses, febrile symptoms of an intermittent type and even rigors, may supervene, whilst the patient becomes drowsy or may be irritable and restless. An abscess may form under the periosteum covering the mastoid process, with or without caries or necrosis of the outer table of the bone, in children where this bony lamella is thin it is not unfrequently absorbed, and on incising the abscess protuberant masses of granulations, springing from the interior of the bone may be seen. When such an abscess has developed the auricle is characteristically displaced downwards and outwards. Not unfrequently the suppuration extends through the bone cells and may encroach on the inner aspect rather than the outer, and hence is likely to lay bare the dura mater and expose the lateral sinus, in such circumstances intracranial complications are possible. Occasionally a few thin walled cells occupy the tip of the mastoid, and

these may perforate downwards into the digastric fossa and thus an abscess may form under cover of the sterno mastoid, and track into the neck, this is known as *Bezold's abscess*

Sometimes the trouble is more chronic, and may be tuberculous in nature, the cells being filled with lymph and inflammatory material of a cheesy nature, whilst the bone itself becomes thickened and condensed. The process feels distinctly enlarged, and is the seat of deep seated pain of an aching character, worse at night. In other cases the discharge is inspissated and mixed with epithelial cells and cholesterine, so as to form flaky masses like the layers of an onion, the condition is known as *cholesteatoma*. It is often the cause of great distension of the antrum.

Treatment—In the early acute stage fomentations may be employed, and the patient kept quietly in bed, whilst the diet is regulated and a



FIG 908—INCISION FOR MASTOID OPERATIONS SHOWING EXTENSIONS UPWARD AND DOWNWARD TO SUIT CIRCUMSTANCES

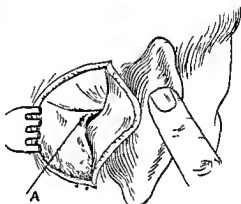


FIG 909—POSITION OF THE ANTRUM (A) DEEP TO THE DEPRESSED AREA CONSTITUTING MAC EWEN'S TRIANGLE

suitable purgative administered. It is most important not to rely upon such palliative measures for too long, but if the symptoms are well marked, the mastoid antrum *must be laid open* and its contents evacuated without interfering with the tympanic structures, which in acute cases are capable of effective repair (*Schwartz's operation*). A curved incision is made immediately behind the ear, which is drawn well forwards (Fig 908), and a gouge applied on a level with the roof of the external auditory meatus, and about $\frac{1}{2}$ inch behind its centre (Fig 909). A small dimple in the bone can often be felt at the required spot, which can also be found by taking the point of junction of two lines drawn as tangents to the roof and posterior wall of the bony meatus respectively. The direction taken by the gouge should be slightly downwards forwards, and inwards. In an adult the mastoid antrum is reached about three-fifths of an inch from the surface of the bone. The surgeon recognizes that he has opened the cavity by the probe, or by the loss of resistance

and escape of offensive pus. The opening is enlarged by the use of the gouge and spoons so as to expose all the affected cells and remove all diseased bone and the cavity is then syringed out. Every cell must be freely laid open into the wound as otherwise the infection will continue to spread through the bone and cause further trouble. All edges must be left sloping with no overhanging lips. The wound is packed with iodoform gauze and should be dressed on alternate days or daily if discharge is profuse. A Bezold's perforation must be enlarged and possibly an incision in the neck may be prevented if the case is treated early.

Chronic Otorrhœa as already explained is a common sequence of an acute attack which may have been purulent from the first or may have been the result of an infection from without of a simple catarrhal otitis media. The membrane is perforated and the discharge varies in amount and character. In uncomplicated cases treatment consists in (1) Improvement of the general health as by the administration of tonics residence in fresh country air and avoidance of chills. (2) The naso-pharyngeal condition must be attended to so as to ensure a patulous condition of the Eustachian tube by which discharges may escape. Steam inhalations or oily prays may be ordered and adenoids and enlarged tonsils may require removal. (3) The middle ear must be kept free from any accumulation of discharge which might undergo decomposition. When the purulent secretion is abundant the meatus should be syringed with sterile salt solution or weak boric acid solution. If the discharge is offensive or difficult to dislodge drops of peroxide of hydrogen (10-volume strength) will be found useful before syringing. If the discharge is slight the meatus may be packed with boric acid powder containing 0.75 per cent of iodine and syringing avoided. Not unfrequently however a persistent discharge from the ear is due to some of the complications mentioned below and further operative treatment may be required.

The **Surgical Complications of Chronic Otitis Media** are often serious and call for prompt treatment. They may be classified under four headings—those affecting the external middle and internal ear and those involving the intracranial contents.

The complications of otitis media affecting the external ear are comparatively unimportant. (a) **Dermatitis** of the meatus is frequently seen and merely needs the parts to be kept dry and clean and a little boric acid powder insufflated. It readily disappears when the discharge ceases but is not unfrequently associated with enlargement and supuration of the cervical glands. (b) **Boils** arise from pyococcal infection of the sebaceous glands or hair follicles in the meatus and are exceedingly painful owing to the denseness of the tissues involved. They should be fomented. A pledget of wool soaked in 5 per cent chinolol and 2½ per cent phenol in glycerine may be inserted and left from fifteen to twenty minutes followed by drops of unguentum hydragrit dil (51) in ol amygdalæ (31). Incision should be avoided if possible because of the danger of causing diffuse cellulitis. (c) Inflammation may occasionally spread to the tympanic plate of the temporal bone leading to subperiosteal abscess and necrosis or it

may extend into the temporo maxillary articulation giving rise to suppurative arthritis

The complications of otitis media in the middle ear are often of a grave nature, and may produce deafness or endanger life

(a) The ossicles become ankylosed or may become carious and be cast off in the discharge, the hearing being impaired in either case but not necessarily destroyed

(b) The inflammation may extend to the bony walls of the tympanic cavity, giving rise to a limited caries or necrosis of the temporal bone. This may be associated with suppuration within the skull and any of the intracranial complications mentioned below The roof of the tympanic cavity (*tegmen tympani*) which is very thin is especially liable to be affected in this way

(c) Polypi may develop consisting essentially of granulation tissue protruding through the opening in the membrane (Fig 905) thereby hindering the escape of the discharge They should be removed by the snare or curette and the base touched with a saturated solution of chromic acid, only, however, in cases where a fistula in the underlying bone has been excluded, the part is subsequently syringed with a weak carbolic solution and dressed antiseptically

(d) Cholesteatomata result from ingrowth of epidermal cells into the tympanic cavity through a perforation Squamous cells are cast off and mix with bacteria and secretions to form a mass which by gradual increase in size, may destroy parts of the bony walls, sometimes causing intracranial complications

(e) Facial Paralysis not uncommonly arises from sclerosis and thickening of the bony tissue surrounding the aqueductus Fallopi, causing pressure on the facial nerve in the canal It must be remembered that the bony canal lies immediately behind the tympanic cavity, and to the inner side of the passage from the attic to the mastoid antrum (*aditus ad antrum*) In a few chronic cases and more especially in those of tuberculous nature the nerve may be actually exposed as a result of necrosis or absorption of the bony wall of the aqueduct and this may lead to direct infection, or even destruction of the nerve itself For symptoms and treatment see p 414

Treatment.—In some chronic cases where discharge is kept up by infection of the mastoid antrum or where complications, such as cholesteatoma or caries of ossicles are present, a more extensive proceeding known as the *radical mastoid operation* is required The auricle is detached posteriorly from the bony margins of the meatus, and then the antrum is opened and the whole of the osseous tissue intervening between it and the meatus and tympanic cavity in front is gouged away All the bone superficial to Hugh Jones's line—an imaginary line drawn from the most prominent part of the external canal to the lowermost part of the bony external auditory meatus—may be removed with safety The facial nerve lies deep to this level The remains of the membrane and the ossicles are removed, and the cavity curetted (Fig 910) The deep portion of the posterior wall of the cartilaginous meatus is incised longitudinally, and the margins of the aperture stitched to the posterior edge of the wound, the meatus thus leading to

the whole of the opening in the bone which can in this way be syringed out and cleansed more efficiently. Thiersch grafting is sometimes employed to secure more rapid epidermatization of the wound in the bone.

Involvement of the Internal Ear or Labyrinthitis may be localized or diffuse and results from the spread of infection inwards either through the wall of the external semicircular canal or through the fenestra rotundum or ovale in the former case the posterior or vestibular portion is involved in the latter the cochlea. Invasion of the semicircular canals is evidenced by vertigo a tendency to fall towards the affected side nystagmus and vomiting pain and fever are present in the more acute forms. Involvement of the cochlea results in tinnitus and absolute deafness. As the perilymph and endolymph systems of the semicircular canals ventricle saccule and cochlea are in direct communication inflammation in one region rapidly involves

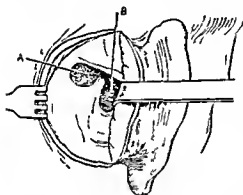


FIG 910 RADICAL MASTOID OPERATION

The antrum (A) has been thoroughly opened up and the bridge of bone covering the aditus removed thus bringing the antrum into free communication with the tympanic cavity (B) which is curetted and the ossicles removed

the other subdivisions. Infection of the meninges often arises by spread of inflammation along the internal auditory meatus.

The intracranial complications of otitis media are relatively more common in the acellular type of mastoid inasmuch as it is almost impossible for the inflammation to extend towards the surface and therefore it is liable to progress deeply.

(a) Extradural Abscess

—For general phenomena connected with this condition see p 888. Accumulations of pus occur most commonly along

the summit of the petrous portion of the temporal bone (Fig 503 B). The patient complains of pain and headache extending over the affected side of the head which gradually increase and are followed by drowsiness lapsing into coma. The temperature is raised but rigors even if present at first are by no means a constant feature of the case. The pulse is of the usual febrile type i.e. quick full and bounding. There is no pain in the neck along the course of the jugular vein but retraction of the head occurs if basal meningitis appears and vomiting is a marked symptom. Optic neuritis may be observed in consequence of the inflammation extending to the membranes at the base of the brain. There may be some tenderness on pressure over the temporal region and possibly oedema. In some cases the pus finds its way outwards along the mastoid emissary vein or through the suture between the occipital and temporal bones.

The **Diagnosis** from *cerebral abscess* is sometimes a matter of considerable difficulty. The symptoms however, set in somewhat more acutely, whilst the temperature is raised, and the signs of irritation of the membranes, such as retraction of the neck, suggest that the lesion is extradural and not cerebral in origin. The pulse is fast and not slow, and focal symptoms are less likely to develop.

The **Treatment** consists in enlarging the opening made in the bone for treatment of the mastoid trouble, so as to ensure efficient drainage.

(b) **Meningitis** may be localized or diffuse. The former is due to extension of infection from the middle ear tract generally through caries of the tegmen tympani or antri, the meninges adhere together and spread of infection is thereby prevented. The diffuse variety is always infective in nature, and secondary to some suppurative affection in the neighbourhood, or to thrombosis of the lateral sinus. The route of entry is sometimes through small veins, spread from the internal ear to the cisterna pontis or basalis may travel through the internal auditory meatus. (For symptoms, see p 884.) Occasionally a simple serous effusion occurs within the meninges, leading to increased pressure and consequent drowsiness. The condition is of extremely serious import.

(c) **Thrombosis of the Lateral Sinus** arises from direct extension of the inflammatory process from the middle ear through the mastoid bone, or it may be set up by an infective thrombosis of the mastoid emissary vein spreading to the sinus. A clot forms within it, possibly at first on one side of the sinus, without completely stopping the blood stream (mural thrombus), this gradually increasing in size, leads finally to occlusion of its lumen. Infection with pyogenic organisms determines disintegration of the clot, infected emboli are detached, and thus pyæmic symptoms originated. In well marked cases the thrombus extends back as far as the torcular Herophili, and downwards along the jugular vein.

The most marked **Symptom** of the case is a sudden rise of temperature which is usually remittent, associated with rigors, vomiting, and localized pain in the head, perhaps most marked over the point of emergence of the emissary vein at the posterior border of the mastoid process. The pulse is rapid, feeble and easily compressible, and in the later stages the patient is drowsy and dull, probably from serous exudation within the meninges. Optic neuritis may or may not exist, being often preceded by photophobia. If the thrombus extends into the neck, a firm tender, elongated swelling is felt in the region of the jugular vein. The cervical lymphatic glands become enlarged, stiffness of the muscles at the back of the neck is an evidence of associated basal meningitis, as also is optic neuritis. Suppuration may occur outside the sinus, or around the vein in the neck, which becomes swollen, red, and œdematous.

In well marked cases the **Diagnosis** is easily made, but in the early stages, and especially in children, it is often a matter of some difficulty. The abrupt onset, the oscillating temperature, the recurrent rigors, the pain in the neck, and the deep tenderness on pressure over the course of the lateral sinus or jugular vein, are the most trustworthy signs of this affection.

Treatment.—An incision is first made along the anterior border of the sterno-mastoid through which the jugular vein is tied, so as to prevent the escape of any more emboli into the general circulation. In old standing cases, where the thrombus has extended into the jugular, the ligature must, of course, be placed on its proximal aspect, and this may involve exposing the vein in the lowest part of the neck, and placing the ligature close to the innominate. A mastoid operation is performed, and by extending its scope backwards the sinus can be exposed. A puncture with a fine needle readily determines whether the sinus contains fluid blood or thrombus, but would not detect a mural thrombus. If therefore, there is any evidence of inflammation or pus around it, the sinus should be opened. The lateral sinus is now freely incised, and the infected thrombus partly scraped, partly washed away, the opening in the bone being increased in size, if necessary. It is desirable, but not essential in the simpler cases, to remove completely the lower part of the thrombus, if this is attempted, the jugular must be opened above the ligature, and the clot syringed or scraped away. Bleeding occurs from the posterior part of the upper opening as soon as all the coagulum is removed, but is easily controlled by plugging the sinus with a small piece of aseptic gauze. The wound in the neck should be lightly packed and not closed, since infection and suppuration are almost certain to follow. The upper wound is also packed in the same way, and allowed to granulate.

(d) **Abscess in the cerebrum or cerebellum**, a complication not unfrequently met with, has been already discussed.

CHAPTER I

SURGICAL AFFECTIONS OF THE EYE .

By N BISHOP HARMAN M A M B (CANTAB) F R C S

THE separation of affections of the eye into medical and surgical groups is a separation of convenience and not of ætiology and in this chapter only those will be considered which arise from injuries or superficial infections or for which surgical treatment is necessary

Injuries to the eyes are common in every walk of life and particularly in industry and as they are frequently the subject of arbitrations or lawsuits for compensation the surgeon should always record carefully in writing with sketches his observations of any case of injury at each time of seeing it The first examination should be systematic and thorough including the vision and condition of each eye When a man is injured his first desire is to know that his sight will be saved and his answers are likely to be correct later the prospects of indemnification may bias his replies Make an examination of the fundus reflexes with the retinoscope determine the character of refraction then test the vision subjectively record the visual acuity as determined by the patient's ability to read the letters of the distance test card Begin the reading with both eyes open and slip a +6D cylinder before the good eye and a +0.25 cylinder before the damaged eye both cylinders with the axes vertical this blocks out the good eye and gives the visual power of the injured eye By reversing the cylinders the acuity of the good eye is obtained With this test the patient does not know that the eyes are being used separately

Foreign Bodies—The entry of a foreign body into the eye is an extremely common accident but may be limited to a great extent by the use of guards to machinery and of suitable goggles in dangerous trades The majority of foreign bodies are removed with ease when once the fragment has been found It is easy to inspect the lower conjunctiva as also the upper fornix when one knows how to evert the lid and then gentle pressure on the eyeball through the lower lid will cause the whole of the upper fold to bulge outwards The inspection of the cornea is less easy especially in brown eyed subjects but for this purpose the reflection of the window or other light on the cornea (Fig 911) may be used the eye should be moved so that each portion of the cornea is employed methodically as a reflector if there is a foreign body on the surface its presence and site will be seen without difficulty by the broken reflex—a wobble in an image that should be stable The removal of the foreign body thus located is usually effected without difficulty by a spud after the instillation of cocaine The choice of a spud is of some moment for the foreign body must be removed with the least possible disturbance of the corneal epithelium If the accident is recent my

mblick shaped spud (Fig 912) may be used, the end is pressed on to the cornea beside the foreign body so as to depress the surface, then a forward movement will lift it off the cornea without scraping the epithelium. If the foreign body is embedded within the epithelium, a chisel shaped spud (Fig 913) should be dipped into the epithelium beneath the foreign body, and thus with some cells should be lifted off



FIG 911

- A Shows the perfect reflection of the window upon the surface of a normal cornea. B Shows the reflection broken at one part by reason of a foreign body on the surface of the cornea. C The foreign body is seen as a black speck against the fundus reflex obtained with the ophthalmoscope

If the foreign body is fixed in the substance of the cornea a needle must be used that will prick into the tissue beneath the foreign body and push it out but this last manoeuvre should not be used except when it is imperative for it damages the tissues and may open up the corneal spaces to infection. Every foreign body involves a certain element of risk from this source and therefore irrigation should follow its



FIG 912—HARMAN'S NIBBLICK SHAPED SPUD FOR REMOVING SURFACE FOREIGN BODIES

The end (shaped like a golf niblick) is pressed vertically on the cornea beside the foreign body thereon a forward movement lifts the object without disturbing the epithelium

removal. With older men there is not infrequently some sepsis of the lachrymal sac and a foreign body in such a subject is likely to be followed by infection resulting in hypopyon ulcer and damage to the sight. For this reason pressure should always be made over the site of the lachrymal sac after the removal of the foreign body, and if there is the least suspicion of regurgitation the sac should be syringed out



FIG 913—SPUD FOR REMOVING FOREIGN BODIES FROM CORNEA

The blade is shown flat and in profile

and examined daily. If the sac is manifestly septic, the puncta should be sealed up by the application of the actual cautery and the sac laid open and drained or else excised.

A complaint of grit in the eye may be the initial sign of an attack of conjunctivitis it is then accompanied by general suffusion of the conjunctiva. Occasionally an eyelash becomes fixed in one of the

puncta, and sets up a local irritation. In summer, the wing cases of beetles may adhere to the cornea and set up a lesion simulating a phlyctenule. Careful examination with a corneal loupe will determine the nature of the lesion.

Penetrating wounds of the cornea are usually produced by chips of metal flying from a rotating machine. The foreign body may project into the anterior chamber, or its track may be seen in iris or lens. If it is projecting through the cornea into the anterior chamber, it should be pushed back by pressure made upon it from within the eye by means of a broad needle inserted through the margin of the cornea into the anterior chamber. If there is reason to suspect that the foreign body is more deeply placed, the pupil should be dilated, and the media and fundus thoroughly explored with the ophthalmoscope. Recourse may also be made to radiography, narrow metal strips should be strapped on the lids and temple, and skiagraphs of the head taken from front and side. If a dense foreign body is present, its shadow can be seen and its position determined by its relation to the shadows of the metal strips. The position of the fragment will determine its treatment. Iron and steel may be removed by the use of an electro-magnet introduced through a wound in the sclera, and sometimes with complete success, but unfortunately in most cases inflammation supervenes, and vision is much impaired.



FIG 914.—BOWMAN'S NEEDLE WITH STOP ON SHANK

When a piece of iron or steel remains embedded in the eye, it becomes firmly encased in fibrous tissue. Chemical action set up by the presence of the metal causes changes known as siderosis, vitreous degeneration and opacities, gross pigmentation of the choroid, and optic atrophy. If iritis should supervene, or the eye is blind, it should be excised without delay for fear of sympathetic disease.

Burns and Scalds, when they affect the eyeball, are usually severe in their reaction, causing intense engorgement of the conjunctiva and much swelling of the lids. Examination of the eye is difficult, but the cornea must be examined, if it appears whitened and dim on separating the lids, serious damage may be expected. Whatever the nature of the accident, whether it be due to steam, flame, lime, or other chemicals, the eye should never be washed with water, but some heavy neutral oil such as olive oil, cod-liver oil, should at once be instilled. Pure cocaine, dissolved in castor oil, may be used to relieve pain. Of course, particles of lime or any other foreign bodies must be picked out. Continuous cold applications to the lids will give much relief, and reduce the risks of inflammation. Each day the lids must be gently separated, and if the conjunctiva has been damaged, a glass rod must be passed between the lids and globe to prevent as far as possible the formation of adhesions between the raw surfaces, and subsequent symblepharon. If such adhesions should develop, they are likely to invert the edge of the lid against the cornea, and then operation is required when the eye is quiet. The adhesion is severed down to healthy tissue, and a graft of

mucous membrane from the patient's mouth or of frog's skin is wrapped round a suitably shaped piece of lead foil and slipped deeply into the wound. The eye is then bandaged over this and left undisturbed for a week. Shrinkages of the conjunctiva are frequent and difficult to deal with.

Contusions of the Eye—In most cases of black eye the eye itself is undamaged. If the eyeball is struck a variety of injuries may result. Traumatic mydriasis is common, the pupil being dilated and the reaction to light poor or absent; the power of accommodation may also be lost. The lens may be concussed with resulting opacities, or it may be dislocated. Vision may be impaired from concussion of the retina without perceptible injury and recovery may follow. Should the macula be damaged or the retina torn vision is seriously impaired and this type of injury may occur when there is no lesion of the anterior portions.

Rupture of the eye with escape of the lens and some of the vitreous may result from a blow. The rupture is nearly always at the thinnest part of the sclerotic, i.e. just behind the cornea. The tension of the eyeball is lost and the anterior may be full of blood. The only treatment lies in excision for the eye will be blind and sympathetic disease has been known to follow.

Penetrating Wounds of the Eye—Wounds of the *conjunctiva* heal rapidly after cleansing with a mild antiseptic lotion. It is unnecessary to suture them unless they are large. Penetration of the *cornea* is serious since the iris is liable to prolapse and vision to be impaired. If the wound is quite fresh the iris may be replaced by a repositor atropine being subsequently instilled freely so as to dilate the pupil to a maximum. Wounds of the *sclerotic* if small heal readily; they should be freely irrigated. Wounds within a quarter of an inch of the corneal margin are likely to involve the ciliary body and may be followed by cycloitis especially if the *ciliary* body is prolapsed or incarcerated in the wound. Inflammatory changes following such wounds are very likely to be followed by sympathetic disease and therefore if after such an injury the sight is found to be lost or nearly so e.g. if only perception of light is retained immediate excision should be performed. If however there is but little impairment of sight the character of the treatment requires most careful consideration. Excision should be undertaken even if the wound of the ciliary region is small when severe iritis follows and it should be urged if the lens is injured or if there is reason to suspect the presence of a foreign body.

Sympathetic Disease The danger of an injury to one eye is not always confined to that eye since the other eye may become affected later by sympathetic irritation or sympathetic inflammation. The affection rarely begins before three or four weeks after the date of the injury and it may be delayed for months or years. A badly damaged eye is therefore a constant menace and children are particularly susceptible.

Sympathetic Irritation shows itself by attacks usually repeated of photophobia, congestion and watering of the eye, failure of accommodation, neuralgic pains in the head and floating bodies seen in the field of vision. Excision of the injured or exciting eye will as a rule stop the trouble.

Sympathetic Inflammation is a terrible disease. It is essentially a fibrinous iridocyclitis. Tough adhesions are formed, fixing the iris to the lens, which becomes opaque, and the vitreous and retina are involved, so that the eye becomes hopelessly blind. The cause of the disease is not definitely known, but it has been attributed to transmission of bacteria through the circulation, to a lymphangitis travelling from one eye to the other along the optic nerves sheath or to a spreading neuritis by way of the ciliary nerves. A recent theory has suggested that it is an anaphylactic condition due to the absorption of uveal tissue thereby sensitizing the body to uveal tissue, and rendering the uveal tract of both injured and uninjured eyes liable to attacks of inflammation. The latest theory is that it is of protozoal origin, for blood-counts in some cases show an excess of large mononuclear leucocytes (24 per cent against a normal 2 to 5 per cent), similar counts occur in malaria and syphilis, which are protozoal diseases. This last theory would suggest the use of salvarsan or its equivalents, and in some cases marked improvement has followed such treatment.

The attack is ushered in by the deep circumcorneal vessels of the uninjured eye becoming engorged, and by the appearance of numberless white spots of lymph, deposited from the aqueous on the back of the cornea, *Keratitis punctata* (Fig 922). They can be seen either by examining the cornea by focal light and the use of the loupe, or with the slit-lamp and microscope, or by direct ophthalmoscopic examination with a +20D lens, when the deposits show up as minute black spots against the red fundus reflex. Attacks of sympathetic irritation that are followed by the appearance of these spots are a danger signal of the gravest order. If no remission of the symptoms is obtained it is almost certain that the disease will progress to the total destruction of the sight of both eyes.

Treatment.—There must be complete rest in a dark room. Mercurial inunctions should be given, with massive doses of salicylate of soda, i.e. 1 grain for each pound of the body weight per diem. If the blood count shows excess of mononuclear cells, a course of salvarsan should be given. Locally, fomentations are employed continuously, and atropine 2 per cent. thrice daily, each night for a week, two or three leeches should be applied to the temple. Atropine is useless when there are old and tough adhesions, it is then an irritant.

In the earliest stage of the disease, the exciting eye should be excised immediately, but if the disease has advanced seriously so that there is little sight in the sympathizing eye, it is perhaps wiser not to remove the exciting eye, since ultimately it may retain the better vision of the two. When the disease has subsided, if any useful vision is retained, it is wise to leave the eyes alone. If after a long period of quiescence it is judged that some improvement of vision might result from the performance of an optical iridectomy, with the extraction of the lens if opaque, this proceeding is justifiable, but there is always some risk that the massive lymph deposits will again shrink and close the aperture.

Excision of the Eyeball.—This operation is most frequently needed for badly damaged eyes, but sometimes for blind and painful eyes, and more rarely for malignant tumours. A general anæsthetic is indicated.

Local anaesthesia by deep injection into the orbit is used by some Continental surgeons, but is not recommended.

The operator stands behind the patient's head. The lid speculum is inserted. The conjunctiva is picked up with fixation forceps, and cut round the limbus as close to the cornea as possible. The cut edge of the conjunctiva is held firmly, and then with curved squint scissors the underlying tissues are divided deeply around the globe as though trying to reach its equator. This manoeuvre is designed to detach Tenon's capsule from the globe, and unless it is carried out effectively, it is not possible to secure the tendons of the recti muscles, which must be severed as the next step. When Tenon's capsule has been opened, the squint hook, with the point pressing against the globe, is slipped round the equator, the hook comes up against the various recti tendons. Each of the four tendons is divided close to the globe, save the internal, which should be left a few millimetres long so as to provide a hold for the next step. The eye is now loose, and pressure downwards of the unlocked speculum will cause the globe to pop up out of the orbit. Grip the tag of the internal rectus tendon with the forceps, and turn the eye towards the outer canthus, then take a pair of strong curved scissors in the other hand, slip them down between the globe and the inner canthus for a couple of inches, until the optic nerve can be felt. Open the scissors so as to include the nerve within their blades, and cut firmly. The eye can then be lifted out, and the dragging bands of the oblique muscles cut close to the globe. Hot water poured into the cavity acts as a hæmostatic, and the conjunctiva is drawn together so as to cover any tags. Several pads of gauze are placed over the closed eyelids and bandaged firmly. The patient may be allowed up in a few days and an artificial eye may be introduced within a month of the operation, it should be on the small side, so that the lids may wipe it completely with each blink. It is well to have two or three shells, and to wear them in turn, so as to prevent irritation of the socket.

Chalazion—This small tumour is due to disorder of a Meibomian gland. These glands are set in the margin of the eyelids. They are the grease glands of the lids. They lubricate the margins, prevent tears running on the face (except when in excess), and prevent soreness from blinking. The glands are long and tortuous. The chalazion is due to microbic infection. A granuloma is produced within the gland, and later this breaks down, producing a cyst like gelatinous mass of cells. The chalazion is then said to be ripe. When in this state the appearance of the lump on the inside of the lid is characteristic. There is a dusky patch encircled with a rim of red. The dusky patch will be found on touching it with a small probe, to be soft. Many attacks of this order will subside after the use of frequent hot bathing to the eye or fomentations. Gentle massage may secure the discharge of the offending cells from the gland. But if these measures fail then the mass must be evacuated by surgical means.

A few drops of cocaine and adrenalin should be instilled. After five minutes the operation may be done. The lid should be everted and held in a suitable forceps so as to prevent bleeding from the marginal artery. There is no more suitable forceps for this purpose than

Graddy's expression forceps (Fig 915). They are better than those with complete rings and plates on the skin blade. Forceps with ratchets or clamps may be dangerous since the lid may be gripped too severely.

The incision should be made with a fine very sharp knife and be vertical to the lid margin. It must never be parallel with the margin for this will mean that other glands are cut. The next step is to scrape out the interior with a small sharp spoon (Fig 915). This is the painful part of the procedure for the cocaine does not penetrate deeply. To diminish pain and make the scraping more effective it is well to dip the spoon into some liquid pure carbolic. The spoon with its droplet of carbolic is then slipped between the lips of the wound deep into the mass of cells. It should be held there for a minute. The carbolic will effectively anæsthetize the interior. It can then be scraped out by quickly rotating the handle of the spoon between thumb and fingers. This is far better than attempting a direct scraping of the walls. The cell mass will be extruded and may be wiped away. Care should be taken to see that none of the granulations is left between the lips of the wound. If the chalazion has been well scraped in this fashion there will be no subsequent bleeding. The conjunctival sac



FIG 915.—GRADDY'S TRACHOMA FORCEPS AND SHARP SPOON

may be wiped clean with lint the midriatic effect of the cocaine neutralized with a drop of eserine and the patient may go home without a bandage. He should be told to bathe the eye frequently with hot water and to use some astringent drops such as zinc sulphate. A chalazion is not a sty. A sty is a pustule on the outer edge of the lid margin in a sebaceous gland attached to a hair follicle. It can be emptied in many cases by pulling out the eyelash. Hot fomentation will promote evacuation. Occasionally it is necessary to pierce the centre with a small sharp knife. It is never necessary to scrape it out.

Conjunctivitis—The conjunctiva is a delicate mucous membrane which lines the inner surface of the eyelids and the front part of the eyeball thereby securing free mobility of both. At the lid margins it is studded with grease glands. It is kept moist partly by the secretions of the mucin from the epithelium but mainly by the tears that flow from the ducts of the lachrymal gland over the front of the eye to the inner canthus where they normally pass down through the lachrymal puncta into the sac and so down the duct into the nose. The mucous membrane on the under surface of the upper tarsal plate is not everywhere quite smooth as it has there many folds and crypts which were formerly described as Henle's glands numerous lymph follicles also are embedded in the submucosa. The epithelial layer of the

membrane is continuous with that covering the cornea, which, indeed, is of true conjunctival origin

Inflammation of the membrane (conjunctivitis) is marked by the four signs of that condition, viz redness from the distension of the



FIG 916—ANGULAR CONJUNCTIVITIS BOTH EYES AFFECTED

The Morax Axenfeld bacillus was cultivated from the discharge on two occasions at the interval of one month. The fan-shaped areas of sodden skin at each canthus are characteristic

vessels, which, since they are little supported, are apt to bleed, heat, from the hyperæmia, swelling, that may be a slight œdema or an intense chemosis, rendering the lids and globe immobile, and therewith the skin of the lids will be glossy, and pain, which is described as like 'grit in the eyes,' even to a severity as though 'broken glass were rolling under the lids.' Lachrymation is marked, the Meibomian glands pour out a frothy secretion, and the mucous cells are over active, leucocytes escape, and thus a secretion is produced, consisting of tears, mucus, and pus cells and in severe cases it may be stained with blood. The discharge clings to the lid lashes and tends to seal the

lids. There is always disturbance of vision, much or little according to the severity of the attack.

Conjunctivitis may arise from a variety of causes. Mild attacks follow exposure to wind, dust, smoke-fumes, or heat. Reflex irritation due to septic teeth, nasal douches, gastritis, or the taking of stimulating foods will produce similar symptoms. Exposure to bright light, such as the arc lamp, ultra violet rays, or snow-fields will cause smart attacks characteristic of 'snow blindness.' Drugs are frequently excreted by the mucous membrane, and if irritating will produce conjunctivitis, e.g. arsenic. Tired eyes from late hours or errors of refraction, cause mild attacks, and these, if repeated, may become chronic.

Epidemic conjunctivitis is common amongst children and unwashed people and prevalent in the dry, dusty months of March to May. Two varieties are described: (1) *Angular conjunctivitis* (Fig 916) which is a mild but chronic condition causing redness of the mucosa and of the corners of the eyelids. There is excessive blinking and the secretion is frothy like beaten white of egg. It is due to infection with the Morax-



FIG 917—FILM PREPARATION OF THE SECRETION SHOWING THE MORAX AXENFELD BACILLUS (X1000)

Axenfeld bacillus (Fig 917) (2) *Muco purulent* conjunctivitis which is a highly contagious form of catarrh. If one member of a household is attacked all are likely to catch it unless toilet arrangements are satisfactory. It is the common pink eye of schools. The eyes are red



FIG 918 —OPHTHALMIA NEONATORUM

Swelling redness and excoriation of lids discharge of thick yellow pus Sixth day after birth disease began third day

and there are minute hæmorrhages there is discharge of muco purulent fluid. The lymph follicles are swollen and visible to the naked eye especially in the lower fornix and sometimes the pre auricular gland is

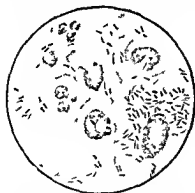


FIG 919 —FILM PREPARATION OF DISCHARGE FROM A CASE OF MUCO PURULENT CATARRH SHOWING THE KOCH WEEKS BACILLUS ($\times 1000$)

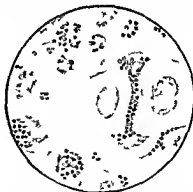


FIG 920 —FILM PREPARATION FROM A CASE OF OPHTHALMIA NEONATORUM SHOWING THE MICROCOCCUS OF NEISSER ($\times 1000$)

enlarged. The infective organism is the Koch Weeks bacillus (Fig 919) a minute organism very like the bacillus of influenza. The attacks may be very severe, and in hot countries are liable to be associated with corneal ulceration.

Since there are many causes of conjunctivitis Treatment must be varied The first step is discovery of the cause especially of those mild attacks which are not of microbic origin The treatment of angular conjunctivitis is easy zinc sulphate is a specific which may be used freely either in $\frac{1}{2}$ to $\frac{1}{4}$ per cent strength as an eye-lotion or better dropped into the lower eyelids with a pipette

For an acute attack of muco-purulent conjunctivitis the mucosa should be cleaned by one painting with some silver preparation either a $\frac{1}{2}$ or 1 per cent silver nitrate solution or one of the colloidal preparations This is followed by free ablution and the use of drops of zinc chloride ($\frac{1}{4}$ per cent) during the acute stage and zinc sulphate ($\frac{1}{2}$ per cent) during the convalescent stage It is important to continue the use of the astringent drops for at least one week after the conjunctiva appears perfectly normal since organisms may be lurking in the crypts and cause a relapse

Acute Purulent Conjunctivitis is a very serious disorder The cases that will attract most attention are those occurring in new born infants *Ophthalmia neonatorum* which is due in 80 per cent of the cases to a gonococcal infection of the eyes of the infant during birth (Fig 920). The inflammation begins usually on the third day The lids are red and swollen and their edges are stuck together by discharge (Fig 918) When they are opened yellowish pus and sanious fluid escape and on evertng the lids the conjunctiva is seen to be extremely congested and velvety There is grave risk of corneal ulceration and sloughing and consequently of incurable blindness 70 per cent of the blindness found in school-children is due to this cause About one child in every hundred born in England contracts the disease and of every 2 000 born one suffers from permanent damage to the eyes Even when the disease is treated successfully and no corneal ulceration ensues it is found that the children suffer in later years from nyctagmus as a result of the closure of the eyes and lack of the stimulus of light during the first few weeks of life Prevention is therefore urgently necessary and much has been done of late years to reduce the incidence of the disease (1) by antenatal measures for the discovery and treatment of vaginal disease in expectant mothers and (2) by making the disease notifiable

Preventive measures are also applied to the baby Directly its head is born the eyelids are wiped free from mucus with clean cotton wool a fresh piece for each eye and as soon as the mother is settled the eyes of the infant are washed with soap and water and then freely irrigated with boracic lotion or Condy solution (2 per cent) The water for the first bath of the child must not get into the eyes separate water and a clean towel must be used for the face At no time during the lying in period may the mother's sponges napkins etc be used for the infant If at delivery there is any suspicion of a purulent vaginal discharge from the mother the eyes of the child must be cleansed as directed and afterwards a drop of silver nitrate (1 per cent) is instilled between the lids (Crede's method) The eyes must be examined and washed at the end of eight hours and if there is any discharge the silver drop may be repeated In case of doubt a bacteriological examination of the discharge should be made without delay

The treatment of *ophthalmia neonatorum* demands efficient and continuous nursing for the oft repeated cleansing of the eyes from the discharge is essential. The eyes must never be bandaged and discharge should be wiped away as soon as it appears. The eyes should be freely irrigated at least six times a day with an abundance of boric lotion but no pressure may be used and no instrument (save a retractor by the surgeon during examination) may be thrust between the lids. After each cleansing the skin of the lids should be dried with cotton wool and greased with vaseline to prevent sticking and excoriation. Once a day after the conjunctiva has been cleansed the surgeon himself should evert the lids and carefully swab the whole mucosa avoiding the cornea with a solution of silver nitrate (1 per cent) in glycerine and water (1-2) or with one of the colloidal preparations of silver. If the cornea becomes hazy or an ulcer appears the treatment is continued but atropine drops (1 per cent) are instilled after each douche.

The discharge is eminently contagious and it is therefore imperative that the patient should be isolated. Great care must also be taken by the nurse and doctor not to infect their own eyes with splashes during the treatment or by their fingers. They should always use rubber gloves and goggles should be worn if an accident should happen the eye should be immediately irrigated and painted with a 1 per cent solution of silver nitrate.

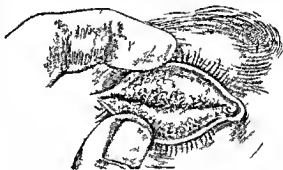


FIG 921 TRACHOMA LIDS EVERTED

There is gross hypertrophy of the lymph follicles and papillae producing a cauliflower like exuberance

Gonorrhoeal conjunctivitis in adults is a very occasional complication of a urethral discharge. The inflammation is intense and the risks to sight are great. Similar treatment should be adopted as for *ophthalmia neonatorum* but a gonococcal vaccine may also be advantageous. When only one eye is affected the other eye must be carefully protected from risks of contamination. A watch glass should be fixed over the eye by strapping with a wick of cotton wool between the skin of the outer canthus to provide ventilation. The nurses and doctor treating these patients must exercise the same care of their own eyes as in treatment of infected infants.

Trachoma is a disease which in its features is the very antithesis of purulent conjunctivitis and yet it is very destructive and the cause for much blindness in countries where it is rife as in Egypt and the Far East. MacCallan found it in 51 per cent of the school children of Egypt hence the name of *Egyptian ophthalmia*. It is seen chiefly among poor dirty and overcrowded peoples. It is very chronic lasting one or

more years in its active form. The presence of the disease may be unsuspected for some time unless the lids be everted. Usually there is a little photophobia with lachrymation. There is slight ptosis and the lid margins are thick and purplish. On everting the lids the upper tarsal mucosa is found most affected; the papillæ are exaggerated so as to look like plush pile (Fig. 921) and the lymph follicles are enlarged and prominent so as to suggest sago grains or frog's spawn (granular lids). The discharge is intermittent and rarely great in quantity but is contagious. As a result of the irritation of the rough mucosa pannus appears in the upper part of the cornea and soft tissue forms between the epithelium and Bowman's membrane and new vessels grow in from above. Many organisms are found in the discharges but the condition may be due to the *B. granulosis* recently isolated by Noguchi from cases of trachoma amongst American Indians. On inoculation into the conjunctiva of certain monkeys the characteristic symptoms of the disease have been produced.

Treatment.—No treatment is known that will produce a rapid cure and attempts to effect this by too vigorous cauterization or scraping away the granulation usually lead to excessive scarring and entropion. Much good may be done by improving the patient's general health and the methodical use of astringents to the everted eyelids for a period of many months. In the discharging stages the lids should be painted daily with a 2 per cent solution of silver nitrate. In the chronic velvety stage the application of solid copper sulphate to the everted eyelids twice a week is the most effective treatment but it is intensely painful. Equally effective but less painful is the use once or twice a week of carbon dioxide snow. A suitably shaped candle of snow is pressed firmly upon the part for from fifteen to twenty five seconds; the tissue is whitened with the cold and reaction follows. The application is painless but there is throbbing as the part thaws. The object of both these forms of treatment is to cause a reaction thus setting up leucocytosis and a subsequent fine interstitial scarring which contracts and destroys the trachomatous process.

At intervals of two months these treatments should be stopped so that the effect may be seen. During the whole time of treatment an astringent lotion such as zinc sulphate $\frac{1}{2}$ to 2 per cent should be used two or three times a day. If it is possible the patient should be isolated so as to prevent the disease spreading to others.

Pannus or vascularization of the cornea is best relieved by treating the lids but when ulceration is present atropine may be required. In old standing pannus with reduction of vision much improvement of sight may be obtained by the operation of peritomy. The conjunctiva is dissected from around the cornea so as to destroy the vessels passing from it into the cornea. The wound soon heals and if necessary the operation may be repeated. In severe cases when the patient is almost blind the scarring may sometimes be reduced by the intervention of an acute conjunctivitis. In former days a gonorrhœal infection was used for this purpose but now a more readily controlled affection can be induced by the use of an infusion of jequirity. Scarring of the lids and painful deformities of the margins and lashes require operation for their relief.

Phlyctenular Conjunctivitis, or Keratitis, is a disease common amongst poor and young children. Cases are rare in the first year of life, but are frequent between the ages of four to six years when the milk teeth are decaying. It is accompanied by intense photophobia and blepharospasm, so that it may be necessary to use a retractor to examine the eye (and this is imperative). The child should be rolled in a blanket to secure its limbs. As soon as the lids are opened, tears spurt out. One or more small whitish elevations will be seen about the limbus heading a leash of enlarged surface vessels. The bleb usually breaks down into an ulcer, spreading towards the centre of the cornea. The affection is probably *herpetiform*, since 70 per cent of the initial lesions in a London children's hospital occurred within the temporo malar quadrant of the cornea, a part supplied by the orbital branch of the second division of the fifth cranial nerve, i.e. in direct connection with the nerve-supply of the teeth. The affected children are nearly always ill fed, and there are commonly nasal discharges and septic mouths. The disease is rare in Jewish children, who consume much fatty food. Treatment consists of cleaning, feeding and medication. Teeth and tonsils must be



FIG 922.—SPOTS IN OR ON THE CORNEA

- A Keratitis punctata small precipitates on back of cornea in iridocyclitis
 B Keratitis punctata large mutton fat precipitates in iridocyclitis with granuloma of iris
 C Dendritic ulcer in surface epithelium
 D Guttate keratitis spots of hyaline degeneration in Bowman's membrane
 E Section of cornea to show Keratitis punctata (see A and B)
 F Section of cornea to show guttate keratitis (see D)

attended to, good food, with plenty of fat and cod liver oil, is essential, natural or artificial sunshine is most beneficial. For the eyes, the use of ointment of atropine and yellow oxide of mercury (1 per cent. of each), applied between the eyelids thrice daily, is most effective. The vaseline base of the ointment forms a warm, soothing covering, the atropine quiets the ciliary muscle and iris, and the mercurial is a stimulus to repair.

Corneal Ulcers in Adults are not very uncommon and are of two types. (1) The *Dendritic* variety is a superficial ulcer which tends to spread in tree like formation from the corneal margin as a fine greyish line with considerable irritation (Fig. 922, C). When fluorescein is instilled into the conjunctival sac, the ulcer shows up brightly green, with characteristic branching and buds. It is best treated by the application of phenol-camphor, a clear solution containing equal parts of pure carbolic acid and camphor. A wooden match should be pointed and the end soaked in the fluid, the wet point should be stubbed into every stained area under cocaine. Atropine ointment is then applied. A second application may be necessary. (2) *Serpiginous* or *hypopyon* ulcer is

a very severe disease and causes much damage to sight. It usually occurs in elderly people of feeble habit and follows some small abrasion which gradually spreads in depth and extent. It is usually accompanied by iritis with profuse outpouring of purulent lymph forming a yellow deposit in the lower part of the chamber (Fig 923 d). The ulcer is of bacterial (often pneumococcal) origin and is sometimes associated with infection of the lachrymal sac. **Treatment**—The ulcer should be cauterized with pheno-camphor and atropine ointment applied followed by hourly fomentations. Leeches to the temple will relieve the pain. If the ulcer spreads despite the use of pheno-camphor it may be necessary to apply the actual cautery at dull red heat around the spreading edge so as to destroy the undermined margin; the base of the ulcer need not be touched. Further it may be necessary to empty the pus from the anterior chamber. A fine Graefe cataract knife is passed through the cornea so as completely to divide the ulcer, both ends of the section being in healthy tissue. Usually it is convenient to let the knife enter the cornea at VI on the clock face and come out at the pivot of the clock hands making a vertical cut. One side of the cut cornea is then depressed so as to permit the clinging pus to be pulled out with fine forceps. Even after the ulcer has healed a large scar will remain and it may be necessary to perform iridectomy at a later date to reopen the pupil.

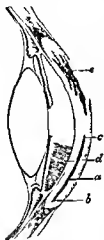


FIG 923

a b c Pus in the substance of the cornea (onyx) d deep in filtrating ulcer with undermined edges d pus in the anterior chamber (hypopyon) a more common condition than onyx

Lachrymal Diseases—The tear glands are tucked beneath the upper roof of the orbit just above the outer canthus. The tears wash over the globe and with each blink of the eyelids are partly sucked and partly squeezed into the sac and so down the duct into the nose. If the puncta do not touch the globe their action is partly lost and overflow of tears or epiphora is thereby caused. In old people with shrinkage of the lids this trouble is common. Massage with lanoline will sometimes render the skin supple and relieve the trouble, but it may be

necessary to operate. A coarse silk suture is armed with a curved needle at each end and each needle is passed within the eyelid to come out on the cheek, where the silk is tied over a well greased roll of lint. The traction of the silk loop suffices to turn the lid inwards and approximate the punctum to the outer conjunctiva and the mild irritation and the lines of scarring which result keep the lid in its new position.

Obstruction of the nasal duct is common; it follows nasal disease and accidental injuries. The obstruction causes the tear sac to become distended constituting a mucocele; pressure over the sac brings about regurgitation of its contents which at first are mucous. Invasion with

organisms follows, and the retained fluid becomes purulent. Acute attacks of inflammation or dacryocystitis follow and the sac must then be incised and drained, just as though it were an abscess. If the obstruction of the duct is impassable it is wise to excise the sac and this becomes imperative in subjects who are exposed to dust and dirt in their work, and thereby run a risk of developing a hypopyon ulcer. The operation is one of some delicacy requiring a precise recognition of the site of the sac.

Acute Iritis is in most cases due to internal infection but may also be caused by an injury. The iris is a richly vascular, muscular and spongy curtain, which, when inflamed is swollen with blood and lymph, and its power of movement is diminished, hence the pupil is sluggish the colour is altered, and its surface becomes gummy and tends to stick to the lens capsule upon which it rests. Diagnosis and treatment are urgent, otherwise the iris will become fixed to the lens by posterior synechæ, and in severe cases the pupil will be blocked and the sight lost. Treatment is general and local. General treatment consists in dealing



FIG 924.—IRREGULARITIES OF THE IRIS

- 1 Indodialis the ciliary processes and lens border and ligament are exposed
- 2 Congenital coloboma of right eye
- 3 Persistent pupillary membrane
- 4 Results of iritis posterior synechæ uveal pigment on lens capsule the pupil is dilated as much as possible by atropine

in an appropriate manner with the cause thus if the iritis is due to syphilis it is obviously insufficient to treat the ocular condition alone. But whatever the cause local treatment is urgent, and it is always the same, *viz* immediate instillation of atropine of sufficient strength to dilate the pupil and tear apart the adhesions. Weak solutions of atropine *e.g.* $\frac{1}{2}$ per cent. are useless, the solution should be at least 1 or 2 per cent. in strength and may advisably be conjoined with equal strengths of cocaine, which assists its action. The atropine may be in watery solution, or in oil or in ointment, possibly the last is the best, as there is less risk of the drug getting on the skin and setting up atropine irritation. Continuous fomentations are also needed. At the outset of the treatment much benefit may accrue from the application of two three or even four leeches to the temple near to the external canthus, this usage will reduce pain and inflammation, and assist the action of the atropine. General medical measures, such as emptying the bowels and the drinking of plenty of bland fluid, are advantageous.

Acute Glaucoma is a disease caused by a disturbance of the balance normally existent between the supply of fluid provided for the nourish-

ment of the eye and its escape from the eyeball. This nutrient and circulating fluid is derived from the vessels of the ciliary body either by transudation or secretion or perhaps both. It passes from the posterior chamber of the eye into the anterior chamber and escapes through the fine spaces in the extreme angle of the anterior chamber between the cornea and the root of the iris. If the fluid is in excess and cannot escape or if the fluid is denser than usual and so passes less easily through the filtration angle the tension of the eyeball increases by reason of its excess contents. Equally if there is loss of penetrability of the filtration angle the same condition will result. Disease will change the quantity and quality of the eye fluid and so render filtration difficult. There is great liability to glaucoma in subjects with small cornea; for it is evident that with a cornea of narrow diameter the filtration area in the rim of the cornea will be much smaller than normal. Also the filtration spaces get furred up with age and there is a tendency for the large lens of age to push the root of the iris forward so as to overlies and perhaps block the filtration spaces. Glaucoma is therefore usually seen in elderly patients; in young people it is generally due to some gross anatomical abnormality. Usual premonitory signs of *acute glaucoma* consist in a rapid increase of difficulty in reading, redness of the eye, pain and dimness of vision and haloes or coloured rings seen about a distant light. With the onset of an acute attack there may be sudden reduction or loss of sight with intense pain over the head combined with nausea or even vomiting. Such symptoms have frequently been mistaken for merely a severe attack of neuralgia or even an acute abdomen. It is therefore essential that the eye itself should be examined regularly when there are suspicious pains about the brows together with nausea.

The eyeball becomes congested and the conjunctiva and the lids may be swollen. The cornea is anæsthetic to the touch of cotton wool and is steamy in aspect so that the iris may not be clearly seen. The anterior chamber is shallow, the pupil moderately dilated and fixed, perhaps oval and there is little or no reaction to light. The lens looks greenish. If the fundus of the eye can be seen there is depression or cupping of the disc. The tension of the eye is raised. This is tested by gentle palpation with the finger tips just as in feeling for fluctuation in a suspected abscess.

Treatment is urgent. Palliative or sometimes preparatory treatment consists in the instillation of eserine drops (1 per cent) into the conjunctiva every hour. Fomentations should be employed continuously and leeches should be applied to the temple and allowed to suck to the full. Even though these measures result in a reduction of the symptoms *as they often will it is not safe to leave the case at this point*. Operation is essential in order to ensure a subsequent free escape of the fluids from the eye and this is best attained by removing some part of the root of the iris by an iridectomy sufficiently wide and well placed to free the filtration angle. This operation in glaucoma demands much experience and skill.

The general surgeon faced with such a case may in emergency relieve the tension of an apparently hopeless eye by a short and speedy opera-

tion known as *sclerotomy*. It is an emergency procedure of much value, and is frequently adopted by ophthalmic surgeons preparatory to iridectomy. An anæsthetic is not essential, though cocaine and adrenalin may be of service. The patient is told to look well downwards; the surgeon stands behind the patient's head and plunges a narrow Graefe's cataract knife deeply into the eye so as to evacuate the excess fluids which well up beneath the *conjunctiva*. The knife is plunged into the eye within the triangle formed by the ciliary body, the tendons of the superior rectus and of the external rectus. The back of the knife must be held towards the cornea so that a jerk of the eye cannot do harm. There is only the momentary pain of the stab and the relief is great.

Differential Diagnosis.—To the beginner the distinction between conjunctivitis, iritis and glaucoma will be difficult, as in all there are disturbance of vision, pain and redness of the eyes; but there are certain sure distinctions. Conjunctivitis is most common in the young, iritis in young adults, and glaucoma in elders. The chief distinction, however, is the *character of the pupil*. If there is a mobile pupil, the likelihood is that the redness is due to conjunctivitis, if the pupil is small and irregular, the cause is probably iritis; if the pupil is enlarged, slightly oval and immobile, glaucoma is present. If examination with a magnifying glass does not make clear in which of these categories a particular pupil is to be placed, it is well to use one drop of a 2 per cent solution of cocaine, or of a 1 per cent solution of homatropine, and watch the effect on the pupil. If the pupil dilates evenly and well it is not iritis, if the pupil dilates with almost alarming rapidity, there is likely to be glaucoma, and then the mydriatic should be immediately neutralized with eserine. For this test atropine may never be used, for it cannot be neutralized with eserine. An examination by the fingers of the tension of the eyeball should be made in all suspicious cases, and every medical student ought to train himself to be able to recognize changes in tension of the eyeball. This is the surest test in distinguishing glaucoma from other conditions.

For one acute attack of iritis the practitioner will see half a dozen mild attacks, or chronic cases. For one of acute glaucoma, he may see a score of chronic cases. In these insidious cases the diagnosis is still more difficult. The use of the mydriatic will discover those of iritis; the use of the *perimeter* will discover those of glaucoma. Attacks of dimness of vision associated with increasing size in the blind spot with a restriction of the peripheral field of vision, and 'cupping' extending over the whole area of the optic disc, so as to suggest an excavation, are characteristic signs of *chronic glaucoma*. The medical and operative treatment of chronic glaucoma requires much thought and care, and both are still the subject of much discussion, and some uncertainty. The prolonged use of eserine is beneficial in some cases, but it does not check the progress of the disease. Operation, by providing a new means of escape for the ocular fluids through a vent, cut with a trephine, at the junction of the cornea and sclera, is undoubtedly successful in very many cases, but not in all.

Squint is a disturbance of the natural balance between the two eyes, so that when one is looking at an object under observation the other is

directed elsewhere. There are two main causes of this disturbance, 1. paralysis, and some derangement of the function of binocular vision, usually in children.

The paralytic form may be due to injury which by fracture of the orbit may involve a muscle or nerve, or by displacement of bones shift the origin of a muscle or to disease which may destroy a nerve nucleus or nerve trunk. In all these cases there is diplopia, or double vision, but if the cause is a fracture with displacement of the origin of the muscle the ocular movements persist, if the nerve root or trunk is involved, loss of movement results owing to the paralysis of the muscle. These cases are difficult to treat. When there is paresis, the simplest means of securing the comfort of the patient and ridding him of the danger of double vision is obtained by wearing spectacles in which the glass before the paretic eye is finely ground so as to prevent detailed vision. When the defect is due to a displacement of a muscle origin, the use of prisms may give relief, or readjustment may be secured by operation.

The commonest form of squint is that seen in children. The determining cause is the absence or suppression of the desire for binocular vision. This faculty varies greatly. In some it is so powerful that odd eyes, defective muscles, and gross inequality of vision will not prevail over the desire for fusion of the images of the two eyes and this will be maintained even though the strain causes severe headache. In others there may be eyes which are equal, of normal focus and standard visual acuity and yet there has been such a lack of development of the brain control of the eyes that there is complete absence of co-ordination, one may be fixed on an object, and the other turned in another direction. Between these extremes there is every grade of disability, and with that the liability to failure of the brain control when conditions of health are unfavourable. So it happens that commonly the onset of a squint is determined by an accidental injury, or some illness. The liability to fail was always there owing to the poor brain control of the eyes, a difficulty increased where there are also errors of refraction or of muscle balance. In children symptoms of double vision at the onset of a squint are very rare though they do occur. The reason for this difference between children and adult squinters arises from the effect of habit. In children the habit of binocular vision is new and easily lost in adults when once fixed, it cannot be lost.

The treatment of squint in children is long and tedious. First, it is necessary to ascertain the refraction of the eyes and to correct any irregularity to the full. Next it is necessary to recover the vision of the squinting eye which is commonly reduced from disuse. The good eye should be covered completely for several hours a day for a period of weeks or months, to compel the use of the squinting eye. Then attempts should be made to get the eyes to work together, to see the images presented to each of them through instruments which act as variable stereoscopes. Finally, it may be necessary to reduce the deformity by operation. Operation has two aims. In young squinters the aim is to put the eyes in such a position of parallelism that they can work together if there be any recoverable binocular vision, and it is obvious that if this aim is to be attained, the earlier an

operation is performed the greater the prospect of success. In older children, operation is performed for cosmetic reasons: a squinting eye is a serious handicap to the prospects of the child, so this handicap must be removed.

In former days operative procedure consisted of tenotomy of a muscle. The practice is unsatisfactory, for undesirable effects follow. Nowadays operations of considerable delicacy are performed which adjust the balance between the opposed muscles: one is shortened or advanced, the other is lengthened by controlled sections. It is important to remember that the successful performance of a squint operation does not render glasses unnecessary.

Cataract.—Cataract is a name given to an opacity within the crystalline lens of the eye of sufficient density to obscure vision. The lenses of very many persons have small opacities or flaws in them, which it is unwise and incorrect to term a cataract. Three varieties will be described: (1) Some few are *traumatic* in origin. The lens may be injured by a foreign body, or wound, resulting in an opacity of greater or lesser extent, according to the injury, or the lens may become completely white. Note has been made of these effects under the section on injuries (p. 1552). (2) Some *children* are found to have cataract in their early years. A few even are born with opaque lenses, and then there is usually bad vision even when the cataract is successfully removed by operation, for it is associated with defective development of the eye itself, as is evidenced by nystagmus, &c. constant movement of the eyes

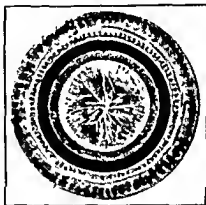


FIG 925.—DOUBLE LAMELLAR CATARACT (X 4)

Focal light pupil dilated fully

due to poor fixation, from lack of development of the macula. Other children have suffered from grave illness in their early years, such as convulsions, and just as these illnesses affect the growing enamel of the teeth, causing them to be rough and pitted, so the growth of the lens is affected. One or more layers are imperfect, so that instead of a lens clear and transparent throughout, there are found layers of more or less opaque tissue which obscure vision. The cataract typical of this state is known as *lamellar*, since the opaque substance forms a layer within the body of the lens (Fig. 925). It is something like the familiar glass alley marble of boyhood days, which showed a layer of coloured or white glass within the clear glass of the marble.

Operation for infantile cataract will be determined by the size of the opacity. In congenital cataract this is often small, and then the best result may be obtained by an iridectomy cut so as to provide a clear hole alongside the opacity through which vision may be obtained. In

lamellar cataract of larger size removal of the lens is necessary it is soft in substance and therefore easily broken up. A needle is passed into the anterior chamber of the eye the lens is cut across from side to side and its depths opened up to the action of the aqueous humour. After a week the anterior chamber will be found to be full of the swollen fragments of the lens. The anterior chamber is then opened at its margin with a broad needle and the lens matter evacuated by coaxing it along a grooved curette. Finally it may be necessary to needle the posterior capsule of the lens. The loss of the lens must be made good by the use of cataract glasses about $+10D$ will be needed to be worn for distance vision and $+14D$ for near vision.

The cataract of adults is an age change. With increasing years there is loss of nutrition. One effect is seen in the whitening of the hair or its loss. The lens grows from the same epiblastic source as the hair and just as the shrinkage of the core of the hair causes the whitening of the hair so shrinkage of the lens with age causes increase of density and occasionally irregular shrinkages with consequent cracking of its tissue. These cracks become filled with fluid and show as white marks in the lens when viewed with focal illumination or as black

marks against the red of the fundus reflex when seen with the ophthalmoscope. Age changes may also affect the central or nuclear region when there is a gradual fogging of the lens the change is very slow and since the outer layers of the lens remain healthy operative measures must be delayed or measures taken to ripen the outer layers of the lens. The most common

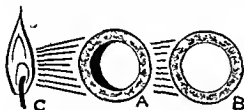


FIG. 926.—THE TEST FOR MATURITY OF CATARACT

C Candle. A An eye in which the opacity is separated from the iris by a layer of healthy lens fibres so a deep shadow is cast by the iris. B The opacity is complete up to the capsule of the lens so no shadow is cast the cataract is mature.

form of senile cataract begins in peripheral changes in the lens with cracks or radiating striae. When these become so advanced as to obscure vision operation must be performed to regain sight.

The test for the maturity of a senile cataract is not difficult (Fig. 926). The iris pupillary margin rests on the lens; if the underlying lens is completely white i.e. cataractous then there will be no shadow cast by the iris edge for the iris and cataract will be in contact (B). If there is in the outer part of the lens some tissue not affected by the cataractous change then the iris will cast a shadow for there is separation between the iris and cataract (A). If a beam of light is thrown upon the pupil from one side these effects will be clearly seen. Further it is necessary to determine the integrity of the fundus of the eye upon which it is proposed to operate for nothing is more disappointing than to discover after the successful removal of a cataract that the patient is unable to see details owing to disease of the retina. The field of vision must be tested by projecting a beam of light upon the eye from varying directions and the patient should point correctly

to the position of the light. Also a light which is capable of being changed quickly into two lights (say a couple of matches held together) must be held before the patient, and the cataractous eye should be able to tell correctly when the light is single or double.

There are many methods of operating for cataract, but the one most commonly performed, and by far the safest, is that known as Graefe's method. The patient is subjected to careful examination to determine fitness for operation and for recumbency for at least one week. The healthy state of the conjunctiva and lachrymal sac is certified. Then operation may be performed. Anaesthesia with cocaine and adrenalin is sufficient. The lids are separated by a speculum. The surgeon stands behind the patient's head. He makes the corneal section with his right hand for the right eye, and with his left hand for the left eye. The section is made with a slender Graefe's cataract knife. The section follows the upper margin of the cornea from the position of X to II on the clock face. It is desirable to carry with the corneal flap some conjunctival flap, for the conjunctiva heals much more rapidly than the cornea. The section complete the iris is gently drawn to the lips of the wound and a narrow vertical piece cut out with scissors. Then, with a pointed instrument the lens capsule is cut across in two directions. Now comes the critical point of the procedure, the evacuation of the lens. With a suitable instrument the upper scleral lip of the wound is slightly depressed to make an easy slant for the delivery of the lens. Pressure is made upon the lower part of the cornea with a flattened instrument. If all the steps of the operation have been correctly performed, if the corneal section is wide enough and the lens capsule has been sufficiently incised, the lens will glide upwards through the wound. Any broken fragments of lens may be removed, or washed out with a gentle stream of normal saline solution. Finally, the cut edges of the iris are replaced within the eye so that no knuckle or tag of iris is left within the wound. Atropine is instilled, both eyes are bandaged, and the patient is carried to bed. Uninterrupted recumbency is desirable, and a bed pan must be used. Slop diet is ordered, and talking must be discouraged. Both eyes should be washed with boracic lotion daily and atropine instilled into the operated one twice daily. After three days, if all is well, the unoperated eye may be left open, and at the end of the week the patient may be allowed out of bed. It is commonly found that the posterior capsule needs to be needled at a later date. Spectacles to make good the loss of the lens will be required, and on the same lines as noted for children.

Since these operations are made in elderly persons, whose eyes are abnormal by reason of the causes that brought the cataract into being, it is inevitable that results will not be uniformly successful. The seriousness of the operation may be appreciated when it is remembered that the eye on a sudden is laid open, its natural inner tension lost, and its vessels, often brittle with age, left unsupported and liable to rupture through any sudden strain from sickness or coughing on the part of the patient. Despite all these risks, however, the great majority of operations are successful, and achieve the restoration of sight to patients who would otherwise be helplessly blind.

CHAPTER LI

SURGERY OF THE FEMALE GENITAL ORGANS.

By EARDLEY HOLLAND M.D. F.R.C.P., F.R.C.S., F.CO.G.

In this account no attempt is made to present the whole subject of gynecology, which extends into the domain of medicine as well as that of surgery, and embraces also the many disturbances which may occur in the sexual and reproductive life of women. All that will be attempted is a concise presentation of the pathology and treatment of the more important surgical diseases, *viz.* the injuries, infections, deformities, and new growths, of the female genital organs, especial regard being paid to those which may be met with in the course of general surgical work.

The female genital organs comprise (1) The external genitalia, which include the *labia majora* and *minora*, the *clitoris*, *urinary meatus*, *hymen* and the *glands of Bartholin*, collectively these structures form the *vulva*. (2) The internal generative organs which include the *vagina*, *uterus*, *Fallopian tubes*, and *ovaries*. (3) The adjacent *musculo-fascial* and *connective tissues* of the pelvis, the pelvic peritoneum, and also various embryonic remnants (Wolffian) which lie in the broad ligament.

Diseases of the External Genitalia.

Vulvitis—Vulvitis, or inflammation of the vulva as a whole, is commonly due to gonorrhœa, uncleanness, or irritating discharges coming from the cervix or vagina, the streptococcus or other pyogenic organisms may also be the infecting agent. The inflamed vulva is covered with a purulent discharge, and the surface is seen to be swollen and reddened. The symptoms are a sense of fulness and burning and itching and the presence of a profuse discharge. In gonorrhœa and other septic infections the infection may spread upwards to the uterus, Fallopian tubes and peritoneum. Bartholin's glands may become acutely inflamed and form localized abscesses. The treatment of acute vulvitis consists in rest in bed, and in keeping the vulva cleansed with a mild antiseptic lotion followed by drying of the vulva and painting with a strong non irritating antiseptic, such as a 2 per cent solution of acriflavine. If an abscess forms, it should be freely opened and drained. The treatment of gonorrhœa has been dealt with in a preceding section.

There are several special types of vulvitis, the incidence of each of which is comparatively rare. Gangrenous vulvitis may occur as a complication of the puerperium or of venereal disease, or of the acute infectious fevers, especially of measles in children, in the latter the

condition may form a local gangrenous area known as *noma*, in which the labium becomes swollen and black and extensive sloughing quickly follows. *Membranous vulvitis* is the result of superficial necrosis associated with streptococcal infection or implantation of the Klebs Loeffler bacillus on the vulva a bacteriological examination should be made before treatment is undertaken in order to ascertain whether the diphtheritic bacillus can be found in which case anti diphtheritic serum should be given without delay. Other rare forms are *erysipelatous vulvitis* and *herpetic vulvitis*.

Leucoplakia vulvæ is a chronic inflammatory disease of the vulva of unknown origin beginning with hyperæmia and superficial cell proliferation. The vestibule and urethral orifice are not affected but the process may extend to the perineum and anus. The affected area becomes thickened and acquires an opaque white colour in the later stages cracks and ulcers may occur which may bleed when touched. In many cases carcinoma supervenes though in others the tissues retract the labium minora and the clitoris almost disappear and the rest of the vulva appears smooth white and shiny. The chief symptom is intolerable itching and the patient cannot refrain from scratching. In the earlier stages soothing ointments or lotions should be applied to the affected parts but if the condition is progressive the whole vulva should be excised not only because this is the only means of ending the intolerable itching but also because of the risk of the development of malignant disease.

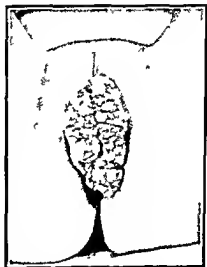


FIG 927—A LARGE MASS OF GONOCOCCAL WARTS

New growths of the vulva may be innocent or malignant. Both are comparatively rare. Innocent tumours consist of *fibroma*, *adenomyoma* or *lipoma*, all of which are most commonly situated on the *labia majora*. They should be treated by local excision. *Papilloma* of the vulva commonly occurs in the form of multiple warts associated with uncleanness or gonorrhœa (Fig 927). The commonest vulval cyst is *Bartholin's cyst* due to occlusion of the duct of the gland. The cyst forms a prominent swelling in the posterior third of the labium majus and contains mucoid fluid. The cyst should be completely dissected out care being taken to include the whole of the gland and duct as otherwise a cyst may re-form.

Carcinoma of the vulva is nearly always a squamous epithelioma but an adenoma-carcinoma occasionally arises from the epithelium of Bartholin's gland or duct. The commonest sites of origin are the

labium majus and clitoris (Fig. 925); much less commonly the tumour begins in the urethra. Growth is usually rapid, and lymphatic spread into the inguinal glands occurs early. In a large percentage of cases the growth is preceded by leucoplakia. The first symptom is pruritus (itching), and later there is a blood-stained discharge from the ulcerated surface. Treatment consists in wide excision of the vulva, together with the inguinal glands in one block of tissue. Alternatively, radium needles may be implanted beneath and around the growth, and the lymphatic areas treated with the deep X-rays, or with radium 'beam-therapy.'

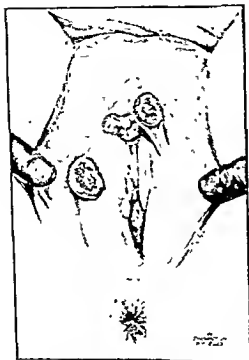
Sarcoma of the vulva is much rarer than carcinoma; melanotic sarcoma is commoner than the non-pigmented variety. Treatment consists in wide excision, together with the inguinal glands.

Urethral Caruncle.—This common and very painful little tumour occurs at the posterior margin of the urethral orifice, either diffusely distributed or as a polypus. It is usually about the size of a pea, is excessively tender to touch, and gives rise to dyspareunia and pain on walking or other movement and on micturition. It may also give rise to slight bleeding. In some cases a urethral caruncle is composed of granulation tissue covered with squamous epithelium, and results from a chronic inflammation of the terminal portion of the urethra.

In other cases it is an adenoma and arises from the urethral glands. Urethral caruncles should be treated by complete excision, which must include the subjacent area of the urethral mucous membrane. Incompletely excised caruncles are liable to recur, but recurring caruncles should always be examined for malignancy.

FIG. 925.—CARCINOMA OF VULVA, WITH LEUCOPLAKIA.

An unusual case, with three separate areas of growth.



Primary carcinoma of the urethra is extremely rare. Prolapse of the urethral mucous membrane is liable to be confused with urethral caruncle. It may either arise acutely, following some

straining effort in which case the prolapsed mass may become purple or black in colour owing to strangulation or more commonly the condition is chronic and implicates usually the floor of the urethra only. *Treatment* consists in excising the prolapsed tissue and in neatly re-forming the urethral orifice.

New Growths of the Uterus

Fibromyomata, or uterine fibroids, are amongst the most common tumours found in the body and are found especially in women between the ages of thirty five and fifty. They are solid tumours composed of a mixture of fibrous and unstriped muscle tissue the relative proportions of which vary in different cases. A high proportion of muscle results in the formation of a relatively soft tumour whereas fibrous growths are densely hard and are particularly found in elderly patients. Typically they are spherical in shape and can be shelled out of the wall

of the uterus in which they grow. They have a poor blood supply and lie in a capsule formed by the adjacent compressed tissues of the uterine wall. They may be single or multiple and may vary in size from a small seed like structure to an enormous tumour which may fill the abdominal cavity. When sectioned with a knife the distinction between the two elements of which the tumour is composed can be detected the paler connective tissue surrounds the darker bundles of muscle which become retracted and give the surface a definite but irregular pattern (Fig 929). About

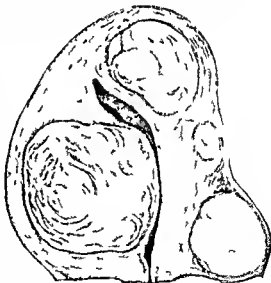


FIG 929—SECTION THROUGH UTERUS REMOVED BY PARTIAL HYSTERECTOMY

Note different positions of tumours in uterine wall

96 per cent of fibroids occur in the body of the uterus and only 4 per cent in the cervix. According to the position which they occupy (Fig 929) they are known as (i) interstitial or intramural in which case they are completely surrounded by the muscular tissue of the uterine wall (ii) subperitoneal in which case they project beneath the peritoneum being covered at their site of projection by the peritoneum only and (iii) submucous in which case the part which lies next to the uterine cavity is covered by endometrium only. Both subperitoneal and submucous tumours may project still farther (Fig 930) escaping alto

gether from the uterine tissue and becoming attached to it by a thin pedicle they are then known as polypoid tumours or fibroid polyp. Tumours growing from the lateral wall of the uterus often burrow between the layers of the broad ligament, and if they grow to any size, strip the peritoneum from the pelvic walls and establish retroperitoneal relations. Thus they may drag the peritoneum off the pelvic colon, and may even burrow and split apart the layers of the mesentery of the sigmoid or of the ascending or descending colon. A subperitoneal, pedunculated tumour may undergo torsion with consequent impairment of the blood supply and necrosis. Owing to their comparatively poor blood supply all fibromyomata are subject to various degenerative changes. Atrophy may occur after the menopause, hyaline degeneration consists of partial necrosis resulting in areas of softening, in fatty degeneration

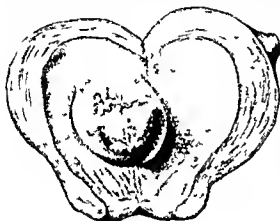


FIG 930—SUBMUCOUS FIBROID PROJECTING INTO UTERINE CAVITY

scattered deposits of fat are found throughout the tumour, in calcareous degeneration lime salts are deposited in the tumour, and in an advanced form the whole tumour may become converted into a petrified mass. Cystic degeneration is comparatively common, and consists in the formation of irregular cystic spaces bounded by ragged walls and filled with a viscid fluid, the cysts arise from

liquefaction of areas of hyaline degeneration. Necrobiosis, or red degeneration, is a peculiar change usually the result of thrombosis of the capsular veins, and is especially liable to occur during pregnancy. On section a necrobiotic fibroid presents a striking alteration in colour varying from pink to deep red. The clinical manifestations are pain and tenderness in the tumour and a rise of temperature. The condition usually subsides spontaneously but occasionally calls for operative interference. Septic infection of fibroid tumours sometimes occurs during the puerperium from extension of infection from the uterine cavity. Sarcomatous degeneration occurs in about one half per cent of all fibroids it leads to rapid growth but is usually unsuspected, and is discovered only after the removal of a supposedly innocent tumour. Fibroids do not undergo carcinomatous degeneration but carcinoma both of the cervix and of the body of the uterus may, of course, occur in association with uterine fibroids.

The symptoms of uterine fibroids vary much in different cases. Even

when of large size they may cause no subjective symptoms. On the other hand the symptoms to which they may give rise are many and various and their occurrence is chiefly dependent upon (1) The extent to which the tumours approach the uterine cavity or project into it (submucous fibroids) or enlarge it (2) Whether the tumours grow in such positions as to cause mechanical effects on the surrounding organs (large fibroids growing from the cervix or in the broad ligament or from the posterior wall of the uterus causing retroflexion) (3) The occurrence of certain forms of degeneration (4) Interference with the reproductive function (5) Rare complications such as septic infection and torsion of the tumour. The commonest symptom is uterine hæmorrhage of the form known as *menorrhagia*, or an increased loss at the menstrual periods. The commonest mechanical effect is retention of urine which is liable to occur with large cervical or broad ligament fibroids, or with posterior fundal fibroids which cause retroversion of the uterus.

Treatment—The treatment of fibroids is surgical. It is not necessary to treat all fibroids merely because they have been diagnosed, the indications for operation are the size of the tumour and the occurrence of symptoms. Even if a large tumour is accompanied by no symptoms, it should be removed as it is very liable to cause trouble sooner or later. A fibroid which reaches half way up the umbilicus may be called large. The symptoms that call for treatment are (1) Bleeding, (2) pain and pressure symptoms (3) evidence of rapid growth. Operative treatment for fibroids is either enucleation of the tumour (*myomectomy*) or removal of the uterus (*hysterectomy*). A fibroid polypus or a small accessible submucous fibroid may be removed by vaginal myomectomy after dilatation of the cervix or after splitting the cervix along its anterior wall and reflecting the bladder (*anterior vaginal hysterotomy*). Abdominal myomectomy and hysterectomy are the operations of choice for most cases. The advantage of myomectomy is that it preserves the uterus as a child bearing organ and it is therefore indicated in women of child bearing age and as it is a more difficult operation and has a rather more unfavourable prognosis than hysterectomy it should be reserved for such cases. The number of tumours is within limits no contra indication to myomectomy although the operation is naturally simpler if it entails the removal of one or of a few tumours only. In women past the child bearing age, or in cases in which it is not desired to preserve the reproductive function, the operation of choice is that of removing the uterus together with the fibroids by abdominal hysterectomy, which may be either partial or complete. In *partial or subtotal hysterectomy* the body of the uterus with the fibroids is removed, but the cervix is left. In *complete or total hysterectomy* the body and cervix are both removed. Complete hysterectomy is the severer operation of the two and is employed only in those cases in which the cervix is lacerated or eroded or inflamed, the reason for this selection is that in such cases carcinoma of the remaining cervical stump is more liable to develop than when the cervix is healthy, and many cases have now been reported of cervical carcinoma arising subsequent to subtotal hysterectomy.

The Operation of Abdominal Myomectomy—The patient is prepared

as for any other abdominal operation, and, in addition, the pubic area is carefully shaved and thoroughly purified. A median incision of suitable length is made between the pubis and umbilicus, and the patient is placed in the Trendelenburg position. The uterus is then drawn up into or through the abdominal wound, and the abdominal cavity packed off from it with sterile cloths wrung out in saline solution. As the hæmorrhage may be troublesome, the blood supply of the uterus is temporarily controlled, the uterine arteries are compressed by encircling the cervix with a special clamp devised by Bonney, and by compressing the ovarian arteries with light rubber-covered clamps as they run in the infundibulo-pelvic ligaments. An incision is then made over the prominent part of the tumour, keeping as closely as possible to the mid line of the uterus, and the tumour is enucleated from its bed, several tumours may be successively enucleated in this way. The resulting cavities, after cutting away such redundant parts of the uterine wall as may be necessary, are then closed with through-and-through mattress sutures of linen thread, and the peritoneal edges finally united by a running suture of catgut. It is important to stop all oozing from the cut surface, owing to the danger, especially if the incisions lie on the posterior wall of the uterus, of adhesions forming to the intestines. If the incisions lie in the anterior wall, the uterus should be suspended by attaching the fundus to the anterior abdominal wall. The uterine cavity may be intentionally or inadvertently opened during the enucleation of the tumours, but this is not a disadvantage unless the uterus is the seat of a septic infection, which would be a contra indication for the operation.

The Operation of Abdominal Hysterectomy.—In this operation there are four main sets of vessels to be secured, the ovarian and the uterine on each side, beginning on one side, a clamp is first placed along the upper half of the broad ligament close to the uterus, another clamp is then placed on the round ligament, and a third is placed over the Fallopian tube between the first clamp and the ovary, the round ligament and the upper part of the broad ligament are then successively divided. If it is intended to remove the ovaries also, the third clamp is placed on the infundibulo-pelvic ligament in order to secure the ovarian vessels. The same procedure is carried out on the other side, and the pedicles are secured by ligatures and the clamps removed. The peritoneum of the utero-vesical pouch running between the distal cut ends of the round ligaments is divided transversely by scissors, and the bladder gently pushed down off the anterior surface of the uterus and cervix. The uterine arteries, as they run up the sides of the uterus are then secured by clamping them against the sides of the cervix about the level of the internal os, and the uterus is amputated above the clamps. A needle carrying a suture is then passed through the lateral wall of the cervix and the arteries are firmly secured as the clamps are gradually released. The anterior and posterior edges of the divided cervix are next approximated by interrupted sutures of catgut after which the raw surface left by the divided broad ligament is closed and all vascular pedicles are buried, by approximating the divided margins of the pelvic peritoneum.

If it is decided to perform a complete hysterectomy, the vagina must have been prepared beforehand by thorough cleansing and by swabbing with an antiseptic solution such as 2 per cent. acriflavine. The operation proceeds as described above down to the clamping of the uterine arteries, after which the paracervical tissue is divided farther downwards on each side keeping as close to the cervix as possible in order to avoid injuring the ureters and having taken the precaution of pushing the bladder completely off the cervix. The vagina is then opened and snipped all round the cervix in order to remove the uterus. All vascular pedicles are secured by ligatures and the divided edges of the vagina are sutured together after which the edges of the pelvic peritoneum are united and all pedicles buried in order to leave no raw surfaces on the pelvic floor.

An **adenomyoma** of the uterus is a growth which combines the structure of a fibromyoma with that of an adenoma. It occurs in two forms (1) diffuse (2) circumscribed. The diffuse form, which is much the commoner, causes a general thickening of the uterine wall, usually the posterior though presenting the usual features of a fibromyoma, it is distinguished by the gradual manner in which it merges into the surrounding uterine tissues. Microscopically gland spaces resembling endometrium are scattered diffusely throughout the substance of the tumour. An **adenomyoma** presents the same symptoms as a fibromyoma, and the treatment is the same.

Uterine Polypi.—The following types of polypi are found (1) Adenomatous or mucous (2) fibroid, (3) placental, (4) malignant. Mucous polypi are very common, appearing as small bright red swellings hanging from the cervix or appearing at the os externum, they occur less commonly in the body of the uterus. In both situations they may give rise to irregular bleeding. A mucous polypus of the cervix is removed by grasping it in a pair of forceps and twisting it off. Small intra uterine polypi are removed after dilatation of the cervix, with a ring forceps or a large curette. A placental polypus arises from the retention of a placental fragment, from which a large polypoid swelling may develop by the deposit of fibrin over the surface. It gives rise to profuse hæmorrhage, and should be removed after dilatation of the cervix.

Chronic metritis or fibrosis uteri, although not a new growth, may be conveniently considered here. It may arise as the sequel of an acute infection of the uterus, but more commonly is the result of puerperal subinvolution. The condition is characterized by a general enlargement in the whole uterus, with a thickening of its wall, in which fibrous tissue predominates. If the condition is due to chronic subinvolution, the microscope will reveal an imperfect disappearance of the new bloodvessels, and especially of their elastic tissue, which had formed during the pregnant state. The chief symptom, which is usually delayed until near the time of the menopause, is menorrhagia which, if unrelieved, may make the patient severely anæmic. Treatment may be by hysterectomy or, preferably, by inducing an artificial menopause by inserting a suitable quantity of radium into the uterine cavity.

Carcinoma of the Uterus.—The uterus and the breast are the two

commonest sites of cancer in the female sex the liability of the two being about equal. Cancer may occur either in the cervix or the body of the uterus the former site being about ten times more frequent than the latter.

Carcinoma of the Cervix—Parous women are more liable to carcinoma in this situation than nulliparæ in the proportion of about 12 to 1. laceration of the cervix and the inflammatory erosions dependent thereon are probably the chief predisposing factors. The majority of cases occur between forty and fifty. The growth may begin (1) on the vaginal portion of the cervix, in which case it is a squamous epithelioma and appears either as a warty excrescence or as an ulcer and (2) in the cervical canal in which case it is an adeno-carcinoma and forms an ulcerated cavity in the substance of the cervix. Squamous epithelioma is far the commoner variety. In both cases spread of the growth both by local and by lymphatic invasion is usually rapid and the vagina parametrium and bladder are all in time invaded the ureter may likewise be infiltrated and obstructed and hydronephrosis septic infection of the kidney and uræmia may all result. The iliac lymphatic glands are the first to be infected and the lymphatic path passes along the base of the broad ligament.

The earliest symptom is irregular hæmorrhage every case of irregular hæmorrhage especially when it occurs after the menopause should without delay be investigated for uterine cancer. The second symptom to appear is offensive discharge which signifies that the growth is already fairly advanced and has become necrotic. Pain occurs comparatively late and always signifies that the disease has become widespread in the pelvic cavity. In early cases on vaginal examination an induration or ulceration or a wart like elevation may be felt on the vaginal portion of the cervix. The tissue is friable and breaks down if scraped with the finger nail or with a probe. In doubtful cases a portion of the suspicious part of the cervix should be removed for microscopical examination. In cancer which begins in the cervical canal there are no external appearances of the disease until it has ulcerated through the cervix but the cervix is bulky and the passage into the canal of a probe or small curette causes hæmorrhage and reveals other evidences of the disease. The extent of the disease should always be estimated by vaginal and rectal examination. If the cervix is freely movable and the bases of the broad ligaments are not indurated the growth is in the operable stage whereas if the cervix is fixed the vaginal walls invaded and infiltration of the parametrium can be detected the disease is usually beyond the scope of radical operation.

Carcinoma of the body is much less frequent than that of the cervix. In this situation the disease arises in parous and nulliparous women with equal frequency and the age incidence is higher than that of cancer of the cervix the disease rarely occurring before the menopause (Fig 931). The outstanding symptom is irregular uterine hæmorrhage which if it occurs after the menopause should always be regarded seriously. Later symptoms are pain which appears much earlier than in cervical cancer and foul discharge. It cannot be too strongly urged that the appearance of any hæmorrhagic discharge near the time of the

menopause should always determine a careful local examination of the pelvic viscera. It is an unfortunate fact that the majority of cases of cancer of the uterus especially of the cervix remain undiagnosed until the disease has reached the inoperable stage.

Treatment of carcinoma of the cervix has altered a good deal during the past few years. Until recently all cases in which there seemed a reasonable chance of removing the whole growth with its lymphatic extensions *i.e.* the operable cases were treated by the operation of extended abdominal hysterectomy devised by Wertheim. In this operation the whole uterus together with the upper end of the vagina and as much of the parametrium and iliac lymph glands as possible is removed by the abdominal route. The operation is a severe one

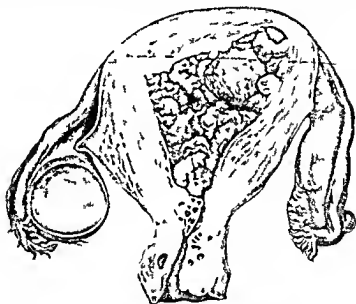


FIG. 931.—SECTION THROUGH UTERUS REMOVED BY TOTAL HYSTERECTOMY SHOWING DEEP INVASION OF WALL AT RIGHT CORNU

with a primary mortality of about 10 per cent. and the prospects of freedom from recurrence for a period of five years amongst the survivors does not amount to more than about 30 per cent. There is an increasing tendency nowadays to discard operation in favour of treatment by radium for all cases including the early ones. The great advantage of radium treatment is that it is accompanied by a primary mortality (from septic infection) of less than 1 per cent. the percentage of five year cures is also rather higher than that claimed by operation. The technique of radium treatment commonly used is that devised by Forsell and Heyman of Stockholm. Three applications are made the second being a week after the first and the third being three weeks after the second. Each application consists of 50 mgms of radium

element inserted into the uterus and 50 mgms disposed in the vaginal vault, the screenage being equivalent to 3 mm of lead. The radium is allowed to act for a period of twenty to twenty four hours. Opinion is still divided about the respective merits of operation and radium in early cases. For inoperable cases there is no doubt that radium is a remarkable palliative, relieving hæmorrhage, foul discharge, and pain in a wonderful manner, and prolonging life.

Finally, a word must be added to emphasize the fact that the predisposition afforded to this disease by a torn and inflamed cervix suggests the possibility of prevention by attending to such lesions, and not allowing them to persist indefinitely without treatment.

In carcinoma of the body the importance of early diagnosis cannot be over emphasized, the interior of the uterus being explored with a curette in all cases of suspicious bleeding. The treatment is removal of the uterus by pan hysterectomy. Treatment by radium or X rays may be attempted when the disease has passed the operable stage.

Sarcoma of the uterus is not common. It may arise as a primary growth, or as a sarcomatous change in a fibro-myoma. The latter is rare, far less than 1 per cent of fibro-myomata showing sarcomatous metaplasia. In most cases it occurs as a solid, firm tumour, consisting of spindle cells but more vascular than and not quite so hard as the majority of fibroids, in others it is of a softer consistency, and may be associated with myxomatous degeneration. It almost always involves the body of the organ, the cervix being unaffected, and it may either attack the mucous membrane primarily as a diffuse infiltration, or constitute a more localized growth in the muscular tissue. Secondary deposits occur in the vagina and elsewhere, and the growth runs a rapid course. The symptoms are uterine hæmorrhage and a discharge which may be offensive and contain debris of the growth. Treatment consists in pan hysterectomy.

Chorion-epithelioma, or chorionic cancer, is a rare tumour of the uterus and is composed of malignant cells derived from the chorionic epithelium, a preceding pregnancy is therefore the invariable source of the condition. The pregnancy may have ended in an ordinary labour or abortion but in the majority of cases the preceding condition is that of **hydatidiform mole**, a portion of which has remained behind after the expulsion of the main mass. Rarely the tumour may occur in the Fallopian tube after a tubal pregnancy. The tumour forms solid nodules of a purple or red colour mottled with pale areas, these appearances being due to the fact that the tumour elements are often surrounded by blood clot originating from the erosion of vessels of the uterine walls by the malignant cells. The tumour cells resemble the normal cells of the chorionic epithelium, and appear as irregular masses of the discrete cells of Langhans layer and of the multinucleated plasmodium of the syncytial layer. The tumour possesses no stroma, and therefore no blood supply of its own, this explains the tendency of the cells to travel into and along the bloodvessels of the uterine wall and the early formation of distant metastatic deposits. The chief symptom is constant or repeated uterine hæmorrhage following abortion,

labour, or hydatid mole. The uterus is as a rule moderately enlarged, but often presents no alteration in size. In some cases the earliest symptom has been hæmoptysis or hemiplegia, from early embolic deposits in the lung or brain. If the case is operable the complete removal of the uterus and appendages should be carried out. This tumour can be regarded as the most malignant tumour known, and the percentage of cures by operation is extremely small.

Tumours of the Ovary and Broad Ligament.

Many different forms of new growth originate from the ovary, and from the embryonic rudiments in the broad ligament. The following classification may be adopted.

A. Unilocular cysts

- (1) From embryonic rudiments (Wolffian) (a) from hilum of ovary (b) from epoophoron (c) from paroophoron. All these have intracystic papillæ ('papilliferous cysts') and all may be carcinomatous.
- (2) Follicular cysts including lutein cysts.

B. Multilocular cysts: the pseudo mucinous cystadenoma

C. Dermoid cysts (teratomatous cysts)

The multilocular pseudo-mucinous cystadenoma is the commonest variety of ovarian cyst, and comprises 80 per cent. of ovarian tumours. It is innocent, and may attain an enormous size. It has a fibrous capsule covered by cells of the germinal epithelium, and is made up of a series of loculi of different sizes separated from each other by septa. There is often a loculus of preponderating size, accompanied by many small loculi of varying size interspersed with semi solid portions. The tumour is of a characteristic pearly-blue colour with a glistening surface. Each loculus is lined by high 'palisade' columnar epithelial cells, many of which are of the goblet variety, the nuclei being at the base of the cells. The cells secrete pseudo mucin, a glycerine like fluid which resembles mucin, but which differs from it in important respects.

Cysts arising from the epoophoron or from the hilum of the ovary arise from Wolffian tubules. They are unilocular and usually contain intracystic papillæ, which may be in the form either of fibromata or of adenomata, in consequence, these cysts are known as 'papilliferous cysts' (Fig 932). They are frequently bilateral, and never attain to the large size of a multilocular cystadenoma. The walls of the cyst are thin and the fluid it contains is watery in consistence. They are often malignant, the type of malignancy being usually more local than general. The intracystic papillæ may burst through the cyst wall by a process of erosion and give rise to secondary deposits on the abdominal viscera and peritoneum, and this is always accompanied by a large accumulation of ascitic fluid. It is important to realize that these secondary deposits often have only a local malignancy, and may disappear after removal of the original tumour, in other cases these cysts assume a definitely carcinomatous character, and spread and infiltrate rapidly. It is not always possible to distinguish clinically between a

papilliferous cyst and an ordinary cystadenoma. It is therefore advisable after opening the abdomen to remove all ovarian tumours entirely without tapping them in order to avoid infecting the peritoneal cavity with tumour cells by the escape of the cyst contents.

Ovarian Dermoids (Teratomatous Cysts)—These tumours constitute about 10 per cent of all ovarian tumours. They are usually unilocular and are sometimes found in combination with a cyst adenoma. They are met with at all ages from the early months of life up to extreme old age. They are frequently bilateral. They grow slowly and seldom attain a large size. The cyst is filled with sebaceous secretion

which is fluid at the body temperature but which coagulates to a solid consistence after the cyst is removed and has cooled. At one area on the inner wall of the cyst is a projection covered with skin which is liberally supplied with sebaceous glands and hair (Fig 933) beneath the skin is a mass of tissue which contains structures developed from all three primary embryonic layers such as teeth bone cartilage thyroid gland muscle intestinal epithelium and neuroglia. The

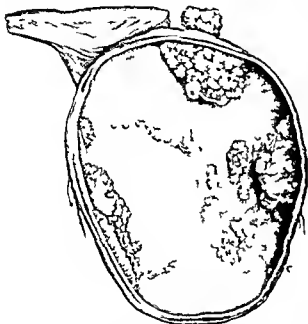


FIG 932 PAPILLIFEROUS EPODIPHORIC CYST
Note intracystic and surface growths

sebaceous contents originate from the skin area of the cyst which is thus really in the nature of a sebaceous or retention cyst.

An ovarian fibroma is a hard pedunculated tumour. It is uncommon and forms less than 2 per cent of all ovarian tumours. It is often accompanied by ascites and is prone to undergo cystic degeneration.

Carcinoma of the ovary may occur either as a primary growth of the ovary or secondary to a growth elsewhere most commonly of the intestinal tract or breast. The tumour may be solid or cystic, and is usually bilateral. About 5 per cent of all ovarian tumours are carcinomatous. The common cystadenoma may undergo carcinomatous change and the papilliferous tumours of the ovary are as has been

mentioned potentially malignant. They are usually accompanied by ascites often blood stained and the abdominal enlargement from this source is usually the first sign of the disease and may make the detection of the ovarian tumour difficult.

A rare form of malignant ovarian tumour is known as the **Krukenberg tumour**. It is usually bilateral and is commonly secondary to cancer of the stomach in a rich cellular stroma lie large cells with clear protoplasm and an eccentric flattened nucleus—the so called signet ring cells.

Cysts of the broad ligament, or parovarian cysts arise from the embryonic rudiments (Wolffian) in the broad ligament they are unilocular with a thin wall and are covered by the peritoneum of the broad ligament which is loosely attached to the cyst wall. They are lined with a single layer of columnar epithelium and warty excrescences are usually present.

Clinical History

—Ovarian cysts in their early stages seldom give rise to symptoms unless they undergo the complications or accidents to be described later. When the cyst has reached a certain size swelling of the abdomen becomes noticeable but even cysts of great size may cause very slight inconvenience. Menstruation is not altered for

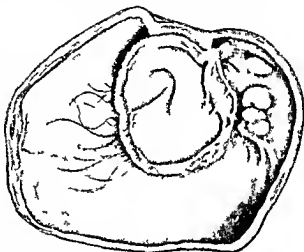


FIG. 933.—DERMOID CYST OF OVARY IN HEMISECTION

Note teratomatous projection in upper part with hairs growing from skin surface

innocent ovarian tumours even when bilateral do not destroy the ovarian follicles or interfere with their ripening or rupture. A cyst which still lies within the pelvic cavity forms an elastic movable tumour beside the uterus which may be normal in position or displaced in one or other direction. When a cyst is large enough to form an abdominal tumour it is felt as a smooth ovoid median swelling whose consistence varies with the thickness of its wall and the tenseness of its contents. A fluid thrill is usually demonstrable through it but in some adenomatous cysts which are partly cystic and partly solid the consistence is variable and the thrill is absent. The mobility of the cyst depends on the length of its pedicle and on the presence or absence of adhesions. A dull note over the cyst is continuous down to the symphysis whereas there is resonance above it and in the flanks.

Diagnosis—Ovarian cysts must be diagnosed from pregnancy, soft or cystic fibromyoma of the uterus, mesenteric cysts, pancreatic cysts, hydronephrosis, ascites, and distended bladder. The passage of a catheter and careful exclusion of the symptoms and physical signs of pregnancy are essential to avoid mistakes in diagnosis. In cases of doubtful diagnosis an X ray examination of the tumour is essential, in order to reveal or exclude the presence of a foetus.

Complications of Ovarian Tumours—Torsion of the pedicle is a common complication, and all ovarian tumours, both cystic and solid, which are of moderate size and are not adherent, are liable to torsion. The effects of torsion depend on the degree of constriction of the blood vessels in the pedicle. If torsion arises slowly and gradually, the thin-walled veins are occluded first, and this results in intense venous engorgement of the tumour and hæmorrhage into the cyst cavity and cyst wall, or into the peritoneal cavity. If both the arteries and the veins are occluded, necrosis of the tumour, with subsequent infection, will occur. Incomplete torsion, leading to a temporary effect, with subsequent readjustment of the circulation in the pedicle, is common. The symptoms are therefore variable, and usually consist of recurrent attacks of lower abdominal pain with tenderness of the tumour. In cases of acute or complete torsion the symptoms are very acute, and consist of agonizing pain, shock, and a degree of collapse which varies with the amount of internal hæmorrhage, the clinical state is, in fact, often that of an 'acute abdomen,' and at operation an ovarian tumour with twisted pedicle may be unexpectedly found.

Rupture of an ovarian cyst may occur spontaneously or as the result of external violence, the former is commoner, and is usually determined by necrotic changes in the cyst wall. The sudden escape of the cyst contents is accompanied by pain and shock, and internal hæmorrhage also may occur from tearing of vessels.

Suppuration of an ovarian cyst is a rare and serious complication, the infection usually originates from adherent bowel or from an inflamed appendix and the *Bacillus coli* is the organism most usually found in the pus. The signs are those of localized peritonitis with the presence of a tumour, and the symptoms are those of severe septic absorption.

Treatment—Early removal by the abdominal route is clearly indicated for all ovarian tumours as soon as they are diagnosed. The earlier they are removed, the safer for the patient, as at any moment dangerous complications may arise, and there is, moreover, always a possibility that the tumour may be or may become malignant. Even in cases diagnosed as malignant, an exploratory operation should be undertaken for in certain of the papilliferous cysts the malignancy is of an essentially local nature, and removal of the main tumour may be followed by the disappearance of peritoneal implantations.

The operation of choice for removing ovarian tumours is ovariectomy. It is a very safe operation, and in uncomplicated cases is one of the safest in surgery.

Operation—The patient is prepared in the usual way for abdominal operations. The Trendelenburg position may be adopted if it enables the pedicle of the cyst to be dealt with more easily. After opening the

peritoneal cavity the tumour should if possible be delivered through the incision without tapping it bearing in mind the possibility of malignancy. If adhesions are present they must be liberated. If it is considered desirable to reduce the cyst by tapping before removal great care must be taken to avoid escape of any of the cyst contents into the peritoneal cavity or abdominal incision by packing carefully all round with sterile gauze before introducing the trocar which should be attached to a suction pump. After the tumour has been delivered the pedicle is clamped with as many forceps as may be necessary and the pedicle is then divided distally to the clamps. If the pedicle is very thin it may be tied *en masse* but it is preferable to secure separately the two chief sets of vessels namely the ovarian vessels in the infundibulo pelvic fold and the anastomotic branches of the uterine vessels close to the uterine cornu. After the vessels have been securely tied and bleeding points have been secured all raw surfaces are buried in order to avoid the subsequent formation of adhesions by sewing together the peritoneal edges of the pedicle. The other ovary is then examined and dealt with according to circumstances after which the abdominal incision is closed.

Broad ligament cysts which have no pedicle are removed by incising the peritoneum of the broad ligament down to the cyst wall and enucleating the cyst from its bed. Before incising the broad ligament the ovarian vessels in the infundibulo pelvic fold and the anastomotic branches of the uterine vessels should be clamped and tied after which a bloodless enucleation can usually be completed. The opening in the broad ligament is then closed.

Endometrioma of the Ovary (Tarry-blood Cyst)—These cysts often bilateral are filled with dark altered blood which has been likened to chocolate syrup or tar. They seldom have a diameter of more than 2 inches and are usually densely adherent to the surrounding pelvic structures. The presence in the wall of the cyst of aberrant endometrium is the characteristic pathological feature and the cyst formation is due to the gradual accumulation of menstrual blood derived from this misplaced tissue. Endometrioma of the ovary rarely occurs before thirty or after forty five years of age. Severe dysmenorrhœa is one of the chief symptoms and attacks of severe abdominal pain having no relation to menstruation occur in a large number of cases.

Infections of the Female Genital Tract

Infections of the female genital tract give rise to a series of inflammatory lesions which are best considered as a whole rather than as affections of the individual organs. In the acute stage of an infection the organs and tissues of the pelvis are always affected collectively. In the chronic stage the *lesion of one organ becomes predominant* but the other pelvic structures also participate to a greater or less extent a chronic pyosalpinx for example being always combined with chronic inflammation of the adjacent peritoneum and of the ovaries. The circumstances under which infections may arise are (1) Gonorrhœa (2) post partum or post abortum (usually streptococcal) infections

(3) post operative infection (4) acute appendicitis (5) tuberculous infection The path of infection is usually an ascending one gonorrhœa and puerperal infection (postpartum or postabortion) claiming between them about 90 per cent of all cases

Acute Pelvic Inflammation—The great majority of cases are due to an ascending infection which reaches the Fallopian tubes and results in acute salpingitis Inflammation of the tube causes no symptoms until the infection has reached the peritoneum and the symptoms of an acute attack are therefore entirely those of acute pelvic peritonitis The severity of the symptoms varies widely in different cases In the most acute usually streptococcal and puerperal the symptoms are often indistinguishable from those of other forms of acute abdomen and no localizing signs may be discoverable in the pelvis in gonorrhœal cases the onset is less severe The initial symptom is sudden acute

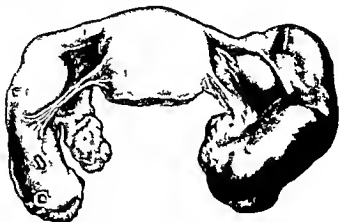


FIG 934—TUBES OVARIES AND BODY OF UTERUS REMOVED FOR PURULENT PELVIC INFLAMMATION

Right tube is a pyosalpinx left tube communicating with an intraperitoneal pelvic abscess

pain located in the lower abdomen accompanied by fever and rapid pulse The patient lies on her back with the knees drawn up and the lower abdomen is tender and rigid Vaginal examination at the onset of the attack seldom reveals any physical signs in the pelvis except tenderness on palpation through the vaginal vault Tender lateral or postero-lateral swellings representing the inflamed tubes and ovaries soon appear and increasing quickly in size may become large enough to rise well above the pelvic brim

An attack of acute pelvic inflammation pursues one of four courses (1) Infection may spread upwards and result in general peritonitis this is almost unknown in gonococcal infection but in streptococcal especially puerperal infection its liability is great (2) An abscess may form either in the Fallopian tube (acute pyosalpinx), in the ovary (ovarian abscess), or in the pelvic cavity (pelvic abscess) (3) The

attack may subside in a few days and leave few or no pelvic physical signs, but the tubes seldom escape permanent damage in the form of kinks, adhesions, and sealing of the abdominal ostia (4) The acute attack may pass into the chronic stage

Chronic pelvic inflammation is associated with the formation of such lesions as **chronic pyosalpinx** (chronic abscess of the tube), **chronic salpingo-oophoritis** (in which the thickened tube is fused with the ovary into a conglomerate mass surrounded by adhesions) (Fig 934), or **hydrosalpinx**. The uterus is usually retroflexed and fixed by adhesions. All these conditions result in chronic ill health, accompanied by pelvic pain, dysmenorrhœa, menorrhagia, and sterility. A chronic pyosalpinx is usually bilateral, forming swellings, usually of unequal size, lying in the postero-lateral regions of the pelvis; the swelling is tender, and can easily be felt on vaginal and rectal examination. A **hydrosalpinx** is a tube distended with clear fluid; it results from a mild infection of the tube which does not proceed to pus formation, and in which the abdominal ostium becomes closed at an early stage.

Treatment—All cases of acute salpingitis whether in the initial stage or during a recurrent attack are to be treated in the first place by expectant or palliative measures. The patient must be kept in bed, the diet limited to fluids, the bowels kept open, and simple measures for the relief of pain adopted, such as sedative drugs and the application of hot fomentations to the abdomen. The patient should be nursed in the Fowler position, in order to assist the infection to remain localized in the pelvis. If however, there arises evidence of general peritonitis, or of the formation of pus, the treatment necessarily becomes surgical.

In the *chronic stage* of pelvic infection, it is often a matter of difficulty to decide whether medical or surgical treatment should be adopted. Chronic pyosalpinx is best dealt with by removing the affected tube or tubes by the abdominal route. When the disease is bilateral the ovaries and uterus are probably infected as well, and a radical operation, including complete removal of the tubes and ovaries and of the uterus, is usually the best operation. In *non suppurative* cases, when an operation is decided upon to relieve pain and other symptoms, or because of recurrent attacks of subacute infection, less radical procedures should be adopted and the ovaries and uterus should, if possible, be preserved.

A **pelvic abscess** must be evacuated as soon as it is recognized, and this is best done through the posterior fornix by the operation known as **posterior colpotomy**.

Tuberculosis of the Tube—The symptoms of tuberculous salpingitis are not distinctive. A tubal swelling or an attack of salpingitis occurring in a young virgin may be suspected of being of tuberculous origin. The usual symptoms are tenderness and pain, the attack being subacute rather than acute, and not accompanied by the same severe symptoms as in the pyogenic forms of salpingitis. Tuberculous salpingitis is often accompanied by tuberculous peritonitis.

Parametritis, or pelvic cellulitis, is inflammation of the pelvic cellular tissue, and is generally due to septic infection following childbirth, the path of infection usually being through a tear of the cervix. It

may also occur secondarily to acute salpingitis. The majority of cases occur in the puerperium and usually make their appearance during the second week after labour. The symptoms are those of any acute infection, namely a rise of pulse and temperature and often an initial rigor. On vaginal examination in the early stages a feeling of fullness is felt at the base of the broad ligament on the affected side and a few days later a hard thick diffuse swelling displacing the uterus to one side makes its appearance. After running a more or less long course the inflammation gradually subsides but in a certain number of cases pus forms resulting in a parametric abscess. The abscess is of course extraperitoneal and usually points above Poupart's ligament near the anterior superior spine. In other cases the abscess points towards the rectum or bladder and may rupture into one or other viscus. Among other unusual situations for the pointing of such

an abscess are Scarpa's triangle, the buttock and the ischio-rectal fossa. When it is certain that pus has formed the abscess must be opened and drained. This may be done through the skin above Poupart's ligament or through the vaginal fornix according to circumstances.

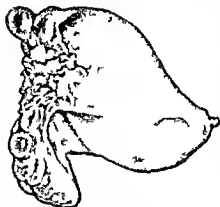


FIG 935 PREGNANT FALLOPIAN TUBE
OUTER HALF

Tube distended with blood ovary
seen below

Extra uterine Pregnancy

It is very seldom that extra uterine pregnancy occurs in any other site than the Fallopian tube about 120 cases of ovarian pregnancy have been reported but the occurrence of primary abdominal pregnancy is not generally accepted. The cause of tubal pregnancy is

often a former salpingitis the kinks and adhesions resulting from which delay or arrest the fertilized ovum during its passage towards the uterus. The fertilized ovum may become implanted in order of frequency in the ampulla isthmus fimbriated extremity or in the interstitial portion of the tube. The ovum penetrates the mucosa and embeds itself in the muscular wall in the absence of decidual formation the trophoblast quickly erodes the wall of the tube and opens bloodvessels. If the erosion is towards the peritoneal coat rupture of the tube occurs with free hæmorrhage into the peritoneal cavity. If the eroding process is chiefly in the direction of the mucosa the tube becomes distended with blood (hæmatosalpinx) (Fig 935) but does not rupture the hæmorrhage is restrained by the wall of the tube and the amount of blood lost is much less than in tubal rupture. In such cases blood usually escapes through the abdominal ostium and gravitates into the

pelvic cavity, where it becomes enclosed by adhesions between the surrounding structures and forms a *pelvic hæmatocele*; the ovum becomes converted into a *tubal mole*, which the tube attempts to expel by means of painful muscular contractions. The process of *tubal abortion* is, however, seldom completed, and blood continues to escape and the *pelvic hæmatocele* to grow in volume. Both *tubal abortion* and *tubal rupture* give rise to characteristic signs and symptoms. Both processes occur very early, usually when the ovum is of the age of three or four weeks, hence the period of *amenorrhœa* experienced by the patient seldom exceeds five or six weeks, and the symptoms often appear within the limit of a normal menstrual interval.

Rupture of the Tube.—The symptoms are usually preceded by a period of *amenorrhœa*, which seldom exceeds six weeks from the date of the last menstruation. The first symptom is a sudden agonizing attack of lower abdominal pain: the patient feels faint and has the symptoms and appearance of internal hæmorrhage, but death from hæmorrhage is rare. Slight uterine hæmorrhage soon appears, due to separation of the uterine decidua. On physical examination the pallor and small rapid pulse denote internal hæmorrhage, the abdomen is full and immobile, is tender on palpation below the umbilicus, and there are signs of free fluid. On vaginal examination the ruptured tube is usually impalpable, but there is great tenderness on vaginal palpation on the affected side. Rupture usually occurs into the peritoneal cavity, but occasionally the tube may rupture between the layers of the broad ligament. In the latter case the loss of blood is not so great as in the intraperitoneal variety, a large hæmatoma forms in the broad ligament, and may become palpable well above the pelvic brim.

Tubal Abortion.—The symptoms of tubal abortion are much less severe than those of tubal rupture. After a short period of *amenorrhœa* the patient is seized with a severe attack of pain on one or other side of the lower abdomen and she feels faint. The attacks of pain are repeated, and uterine bleeding usually slight, and often accompanied by the passage of a decidual cast, soon makes its appearance. On examination a pelvic swelling is always felt, but the exact physical signs are variable depending on the size of the tubal swelling and of the *pelvic hæmatocele* respectively. If the bleeding is confined to the tube (*hæmatosalpinx*), an ovoid swelling extending across the pelvis or lying in Douglas's pouch can be felt, but if there is a large hæmatocele the distended tube is masked, and can seldom be felt as a separate swelling. A *pelvic hæmatocele* usually forms a doughy mass in the pouch of Douglas, bulging forward the upper part of the posterior vaginal wall and displacing the uterus upwards and forwards.

The ovum is almost invariably destroyed at the time of rupture or abortion, but in rare cases it may continue to live and gain new attachments within the broad ligament or in the peritoneal cavity, and pregnancy may continue even to the full development. Such cases of *full-time extra-uterine pregnancy* are of great rarity. The child is usually dead, and is deformed from pressure.

Treatment of Extra uterine Pregnancy.—As soon as the condition is diagnosed, immediate operation should be undertaken. The abdomen

is opened, the affected tube identified and removed, and the blood-clot cleared out of the pelvic cavity. It is usually possible, and always advisable, to preserve the ovary on the affected side. The danger of delaying operation is that fresh and possibly fatal hæmorrhage may occur. A pelvic hæmatocele which has become infected should be drained through an opening in the posterior vaginal fornix (posterior colpotomy). In cases of severe intraperitoneal hæmorrhage, intra-venous saline infusion or blood transfusion may be required.

Displacements of the Uterus and Vaginal Walls

Prolapse.—The various forms of downward displacement of the uterus and vagina are best grouped under the comprehensive term **prolapse**. Prolapse is a hernial protrusion of the pelvic viscera through the vaginal orifice, and the chief primary lesion which initiates the process is weakening of the fibro-muscular attachments between the viscera and the fixed pelvic structures, when such weakening exists, the ordinary intra-abdominal pressure suffices to produce prolapse, which tends progressively to increase and is always aggravated by muscular effort. Prolapse is perhaps, the commonest gynaecological condition met with in practice and its subjects are nearly always parous women in whom the attachments of the uterus and vagina have been overstretched or torn during labour. As, however, the condition sometimes occurs in nulliparous women it must be supposed that a primary weakness of these attachments sometimes exists. A patient is best examined for prolapse lying on her back with the legs widely separated and the knees bent when she is made to strain down or cough, the prolapse will become evident at the vaginal orifice or will be increased.

Clinically four types of prolapse may be observed, and they may occur either singly or in combination.

1. **Cystocele.**—The vaginal orifice is wide, and part of the vaginal wall is exposed when the patient strains down, the anterior wall bulges outside the orifice in the form of a round smooth swelling 'like an egg'. The bulging pouch of the vagina contains more or less of bladder or urethra as may be demonstrated by passing a bladder sound. As a rule there is no accompanying descent of the uterus.

2. **Classical Prolapse or Prolapsus Uteri.**—This is the commonest form and three stages may be described. In the first stage, the anterior vaginal wall bulges as in cystocele, and at the same time the uterus descends and becomes retroverted. In a later stage, the anterior vaginal wall is completely everted, the cervix appears at the vaginal orifice and about half the posterior vaginal wall is inverted from above downwards. The final stage is known as **complete prolapsus uteri**, or **procentia**, the vagina is turned completely inside out, and hangs outside the vulva with the cervix at the apex of the protruding mass, within which lie the uterus, bladder, and urethra.

3. **Rectocele.**—When the patient strains, the posterior vaginal wall bulges outside the vaginal orifice in the form of a swelling which contains a pouch of rectum as is easily demonstrated by rectal examination, the anterior vaginal wall and uterus maintain their normal position.

4 **Inversion of the Vagina from above Downwards.**—When the patient strains, the cervix appears outside the vaginal orifice, the vaginal wall descends with the cervix, the vagina being inverted from above downwards, but there is no cystocele or rectocele.

All these types of prolapse may occur singly or in combination, thus rectocele and cystocele are often combined, and either or both may be associated with classical prolapse or with inversion of the vagina from above downwards.

A patient with prolapse complains of 'something protruding,' and of discomfort on walking or standing. In long standing cases the everted vagina becomes rubbed, and ulceration and infection may follow. With large cystoceles the bladder is not completely emptied, and residual urine collects and decomposes with cystitis and sometimes infection of the kidney as sequels.

Treatment—Palliative treatment consists in inserting a vaginal ring pessary. This form of treatment does not cure the condition, but merely relieves symptoms by affording a temporary support in the manner that a truss controls a hernia. A pessary acts as a foreign body in the vagina, acting as a constant irritant, keeping the walls on the stretch, requiring to be changed at regular intervals, and condemning the patient to much discomfort and inconvenience for the rest of her life. Unless the age or general condition of the patient contra-indicates it, all forms of prolapse should be submitted to operative treatment, which entails very small risk and is almost invariably successful.

The operation which is nowadays performed is a combined vaginal and perineal plastic operation which aims partly at tightening the relaxed fascial supports and restoring the cervix and bladder to their normal level, partly at reducing the area of the stretched vaginal walls, and partly at narrowing and building up the distended vaginal orifice and perineum.

For cystocele the operation of **anterior colporrhaphy** is performed, for rectocele the operations of **posterior colporrhaphy** and **perineorrhaphy**, and for the combined forms of prolapse all three operations in combination, in cases of elongation of the cervix, amputation of the cervix is carried out in addition.

Backward Displacement of the Uterus.—The normal position of the uterus is one of anteversion and antelexion, the long axis of the uterus inclining forwards with an obtuse anterior angle between the cervix and the body, it must be clearly borne in mind, however, that the uterus is not fixed in this position, but is free to move in all directions.

A **retroversion** is a rotation of the whole uterus on a transverse axis passing through the cervix, so that the long axis is inclined backwards instead of forwards. A **retroflexion** is a bending backwards of the body of the uterus on the cervix, and is invariably accompanied by retroversion. Retroversion is frequently a normal condition, and is estimated to be present in about 20 per cent of healthy women, it causes no symptoms, and does not interfere with normal uterine function. Retroflexion is extremely common in women who have borne children, and is not uncommon in nulliparæ. It most commonly arises during the early days of the puerperium, owing to the relaxed

state of the uterine attachments at that time, the uterus in this position cannot complete its normal puerperal involution, and remains in the state of 'chronic subinvolution'. In other cases retroflexion arises as the result of pelvic inflammation, being dragged backwards by the weight of the inflamed appendages. Many cases are congenital in origin.

Diagnosis—On vaginal examination the cervix is found pointing downwards and forwards and the body of the uterus is felt through the posterior fornix. On bimanual examination the diagnosis is confirmed by failure to palpate the body of the uterus through the anterior fornix.

Symptoms—It is generally accepted that a healthy retroflexed uterus seldom causes symptoms. There are, however, three symptoms or signs which are occasionally the direct effects of retroflexion of the uterus—namely dyspareunia, sterility, and abortion.

Treatment—In cases in which retroflexion of the uterus gives rise to symptoms the uterus may be replaced by manipulation and kept in the normal forward position by the insertion of a Hodges's pessary. A pessary acts only as a temporary support, and never permanently cures the displacement. A permanent cure can be obtained only by submitting the patient to the operation of ventral suspension, in which the uterus either directly or indirectly through the round ligaments is sutured to the abdominal wall just above the level of the symphysis pubis.

Malformations.

Errors of development of the uterus from variation in the process of fusion of the Mullerian ducts are not uncommon, but malformations of the other organs apart from stenosis of the lower end of the vagina are rare. Congenital absence of the ovaries, except in association with some such gross foetal monstrosity as acardia, never occurs. A number of cases have been recorded in which an ovary has been arrested at some point along its line of normal descent through the abdomen, and an ovary may sometimes be found in the sac of a congenital or acquired hernia.

Malformations of the Fallopian tube are infrequent, the most usual are the presence of supernumerary ostia and congenital diverticula, the latter having an important bearing on the ætiology of extra uterine pregnancy.

Malformations of the Uterus—Congenital absence of the uterus is extremely rare, even in cases of so-called 'absence of the uterus' a small nodule of fibro-muscular tissue can usually be found. The uterus *fœtalis* represents the proportions of the uterus as usually seen at birth, the whole organ being very small and the cervix forming two-thirds of the whole; menstruation is generally absent. The uterus *pubescens* represents the persistence in adult life of the organ as found at puberty, its length may be normal but it is often narrow and may be acutely anteflexed; the condition is usually associated with scanty menstruation, dysmenorrhœa and sterility. Another class of uterine malformation is due to defective development and fusion of the Mullerian ducts, and the defects vary from the presence of two complete uteri (uterus

didelphys or double uterus) to a depression in the fundus which denotes the slightest degree of imperfect fusion. An important form clinically is the *uterus bicornis* with a rudimentary horn, in which the latter is as a rule attached to the single cervix by a band of fibromuscular tissue. Dysmenorrhœa is a common symptom and there may be retention of menstrual fluid (*hæmatometra*) in the rudimentary horn. Pregnancy may also occur in such a horn leading to the symptoms of extra uterine pregnancy. In all the above malformations the cervix and vagina may be single or double.

Absence of the vagina occasionally occurs in which case the uterus though present is usually rudimentary. Should the uterus be functional the condition of *hæmatometra* (retention of menstrual fluid in the uterus) will of course result.

Localized atresia is a common defect of the vagina and the obstruction is usually due to the persistence of a membrane at the vaginal orifice—the so called ‘imperforate hymen’. The obstructing membrane after the establishment of menstruation obstructs the flow of menstrual fluid which distends the vagina and gives rise to the condition known as *hæmatocolpos* if the condition is allowed to persist unrelieved the uterus and Fallopian tubes may in turn become distended (*hæmatometra* and *hæmatosalpinx*). The symptoms are absence of menstruation, colicky pains in the lower abdomen and sometimes retention of urine from pressure on the urethra. The condition must be relieved by incision of the membrane and liberation of the accumulated fluid which is dark red and viscid.

Malformations of the vulva are usually associated with the various types of pseudo-hermaphroditism.

Injuries of the Female Genitalia.

The female genitalia are in such a well protected situation that injuries other than those due to parturition are rare. Injuries to the external genitalia may occur from direct violence such as a fall astride some object or from intentional kicks or blows. The hymen and vaginal orifice may be severely torn in the newly married resulting in hæmorrhage which may require surgical attention and cases of rupture of the vaginal vault from the same cause have been reported. The parts are richly supplied with bloodvessels particularly veins and slight injury may cause severe hæmorrhage either external from an open wound or subcutaneous in the form of a large hæmatoma in the pregnant state especially if large varicose veins are present in the labia. The likelihood of severe hæmorrhage is greater. If a hæmatoma forms the labium becomes greatly swollen and discoloured firm to the touch and extremely tender and painful. Suppuration may follow especially if the injury is associated with a superficial wound. A very large hæmatoma occasionally arises spontaneously during the second stage of labour tracking up the side of the vagina and hindering parturition. Occasionally a fall on a stick or pole may result in laceration of the recto-vaginal septum.

Treatment—Open hæmorrhage from injuries to vessels should be

stopped by ligature or by packing, or by ligature of the tissue *en masse*, as indicated by the nature of the wound. Wounds should be cleansed by antiseptic solutions and subjected to primary suture, if possible. After treatment of the wound the patient should be kept in bed with the hips elevated. A hæmatoma should be treated conservatively in the first place, but if suppuration occurs, incision and drainage will be required. If a large spontaneous hæmatoma forms during labour and obstructs the exit of the child, the swelling must be incised and the clot turned out.

Injuries resulting from Childbirth.—Slight injuries in the form of laceration of the vagina and perineum are extremely common, and as a rule heal without complications as the result of immediate suture. Severe injuries are nowadays met with much less commonly than in the past, thanks to the improved standard of obstetrical practice. The injuries to be considered here mostly represent the failures in the primary healing process. They may be considered as follows (1) Unhealed lacerations of the perineum, incomplete and complete, (2) unhealed lacerations of the cervix, (3) vesico-vaginal fistulæ, (4) recto-vaginal fistulæ.

Lacerations of the perineum are the commonest injuries of the birth canal, and are divided into complete and incomplete. In complete laceration the sphincter of the anus is torn through, and sometimes the rectum itself is laid open for a considerable distance. The symptoms of an unhealed incomplete laceration are not very pronounced, and consist in discomfort and a sense of weakness in that region, and there is a predisposition to vaginal prolapse. The symptoms of a complete tear are, of course, much more noticeable to the patient and demand relief by operation, flatus and faecal matter escape involuntarily, especially if the motions are loose, and life is thereby rendered a misery.

Treatment.—The treatment of perineal lacerations consists in their repair by the operation of **perineorrhaphy**. The first step in the operation is to excise the superficial scar covering the surface of the laceration after which the vaginal mucous membrane, the deeper tissues, and the perineal skin are united by sutures, so as to restore the parts to their original condition. In complete lacerations, the first important steps of the operation are the freshening and suturing of the edges of the tear in the rectum and the union of the torn ends of the sphincter ani.

Lacerations of the cervix, if accompanied by chronic cervicitis and erosion, give rise to muco-purulent vaginal discharge, they also predispose to cancer of the cervix. Treatment consists in repair of the laceration by the plastic operation of **trachelorrhaphy**, or in amputation of the affected part and plastic reconstruction of the cervix.

Vesico-vaginal fistulæ are repaired by an operation the principle of which is excising the edges of the fistula and suturing the openings in the bladder and vagina in separate layers.

Recto-vaginal fistulæ are usually associated with complete laceration of the perineum, and are dealt with by the operation above described for repairing that injury, especial attention being paid to freshening and uniting the edges of the torn rectal wall.

CHAPTER LII

TROPICAL SURGERY.

By SIR FRANK POWELL CONNOR DSO, MHS, FRCS

It is scarcely necessary to insist that there is no essential difference between surgery as it is practised in temperate and tropical climates. Probably it is more difficult to maintain asepsis in the latter, but that merely necessitates a more meticulous care in technique than in other climes. The chief differences which warrant a chapter being devoted to the subject lie in the character of the lesions which present themselves for treatment and the striking variations in incidence due to the effects of climate, dietary and other environmental conditions on the human organism. Space will not permit of these being discussed at length, but a few may be mentioned such as the enormous incidence of gastro-duodenal ulceration in certain restricted areas, as in South India, probably due chiefly to vitamin deficiency, the great frequency of buccal and maxillary cancer in districts where plugs of betel leaf and lime are chewed, the great prevalence of stone in the bladder in certain areas, the much greater frequency of sarcoma as a variety of malignant disease of tropical countries. These and many other surgical problems provide a large field for practice and research. Many varieties of cutaneous affections occur which are quite unknown in temperate regions. This is probably due to a more receptive condition of the skin, and the greater activity of various types of organisms which are able to attack it. These are dealt with first, and then conditions will be considered which result from various tropical fevers and intestinal diseases.

Infective Granulomata.—Diseases of temperate climates, such as tuberculosis and syphilis, are well known in the tropics, but we have also to consider others which are peculiar to hot countries. The following is a convenient classification.

- (a) Tuberculosis.
- (b) Syphilis.
- (c) *Framboesia* (or yaws).
- (d) Leishmaniasis.
- (e) Tropical granulomata, including granuloma venereum, inguinal lymphogranuloma (or climatic bubo), diffuse spirochætal papillomatosis.
- (f) Granulomata caused by pathogenic fungi. Actinomycosis, mycetoma, blastomycosis, rhinosporidiosis, mossy foot.
- (g) Rhinoscleroma.

Tuberculosis is a very common disease in hot countries, and is responsible for an enormous mortality. The disease is widespread, but

particularly favours hot and moist districts and the deep valleys of mountainous tracts. Aboriginal tribes living remote from civilization may be free from infection but suffer more severely when they are contaminated by intercourse with more populous areas.

All clinical and pathological types of tuberculous disease occur but surgical lesions are less common than in colder and less sunny regions. Skin lesions superficial lymphadenitis and even bone and joint infection are not as much in evidence. Pulmonary and generalized forms of tuberculosis are frequently met with alone or complicating other surgical diseases. Masses of tuberculous granulation tissue or of breaking down in caseous areas are most often seen in individuals of low resistance or those coming from localities where tubercle is little known. Intestinal and mesenteric involvement are much rarer than in Europe suggesting a lower incidence of bovine tuberculosis but it must be remembered that unboiled milk is seldom used by residents in the tropics. Curiously tuberculous lesions of the ileo-caecal region of the bowel in adults are not very uncommon and may be mistaken for a new growth.

Syphilis.—This world wide disease is exceedingly common in tropical lands except among isolated tribes. In Uganda 90 per cent of the inhabitants were found to be infected (Lambkin). The disease is regarded as of no importance among the ignorant and working classes owing to the fact that the early primary and secondary symptoms produce little suffering.

The *primary lesion of acquired syphilis* is as often as not unnoticed owing to carelessness and because of the common incidence of soft sores and mixed affections which appear much earlier and attract more attention. Phagedænic ulceration is often seen and may cause much local destruction. The typical Hunterian chancre is comparatively rare. Extragenital chancres are generally allowed to run their course without any specific treatment. In females the difficulties of diagnosis are accentuated by greater diffidence in seeking medical aid, and owing to the fact that the lesion may be more concealed and is more liable to be complicated by gonorrhœa and soft sores than in the male. Owing to these various circumstances it is inadvisable to accept the patient's statements when noting the case-history. It is necessary to rely entirely on a bacteriological examination or the Wassermann test.

The *secondary stage of syphilis* may also be missed by patients in the tropics. This is not to be wondered at in the case of pigmented skins and when the body is covered with prickly heat and various parasitic skin eruptions. The early roseolar rash is not easily identified except in its later stages when the site of each macule becomes pigmented. Papular and pustular rashes are not uncommon quite early in the secondary stage and scab formation may be exaggerated producing a rupial appearance.

Mucous membranes are less affected than in European countries and sore throat is less complained of but condylomata round the anus are very common. Irregular fever may occur and may be mistaken

for malaria, and in Europeans tropical conditions seem to produce a greater liability to meningeal involvement late in the secondary stage marked by headache and nervous irritation. Ocular signs are very common, particularly iritis and lead to much impaired vision in untreated cases.

The *tertiary stage of syphilis* does not produce anything like as much disability in hot countries as would be expected when one considers the almost universal distribution of the disease in some localities. It is true that horrible mutilations of the nose and naso-pharynx are met with, but these are not very common. Among the commoner tertiary lesions are bone affections, such as periostitis, subacute osteomyelitis, and caries, ophthalmic nervous lesions are seen in great numbers, para-syphilitic nervous lesions are quite rare, vascular complications are most marked at the aortic base and aneurism is seldom met with. The infrequency of para-syphilitic lesions may be accounted for by a smaller incidence of the neuropathic form of syphilis but it is probably due to the fact that the infection is less often driven into the deeper tissues by partial treatment.

Congenital Syphilis is responsible for an enormous infant mortality and for gummatous lesions involving mucous membranes, bones, and viscera. These are not as commonly met with as would be expected, and this is probably explained by the fact that most cases of severe infection die during early childhood.

Most of the above remarks on syphilis refer to parts of the tropics where the disease has been in existence since its introduction into the Old World. In newly infected regions it runs a much more acute course.

Framboesia, or Yaws, is a specific contagious disease characterized by a granulomatous eruption. It occurs in restricted areas of the following tropical countries: India and Ceylon, Malay States, West and East Indies, Papua, China, Pacific Islands, and Africa. The causative organism is *Spironema pertenue* (Castellani), which is morphologically identical with *S. pallidum* of syphilis.

Clinical Features—Yaws closely resembles syphilis, and the Wassermann reaction is positive in both diseases, but there are various differences which will be referred to later. The infection is conveyed through abraded skin directly or by means of flies and other insects, and among primitive or crowded people all are infected sooner or later. There is no evidence of antenatal infection, and the disease is commonest in children and among males. One attack confers considerable immunity. As in syphilis, the symptoms of yaws are usually described as occurring in three different stages.

The *Primary Lesion* usually appears as a papule from two to three weeks after infection, and may develop into a typical granuloma or a scabbed ulcer, or, as in syphilis, it may pass unnoticed in some cases. The site is seldom genital, the following regions being most often involved: the lower leg, arm, thigh, buttock, and breast. If untreated, the sore will usually continue into the secondary stage. Symptoms, such as fever and headache, together with vague pains in the body,

may appear, and the primary yaw itself may cause pain and irritation for a few days

The *Secondary Stage* is marked by an eruption which appears ten to twelve weeks after infection as multiple papules, scattered or in groups, which develop into the characteristic 'frambæsia,' or yaws. This may be preceded by a fine desquamation in patches. The lesions are insensitive, but the adjacent skin may become very irritable. The Wassermann reaction begins to be positive about the eighth week, and is well established at the end of the secondary stage. The typical 'yaw' of the secondary stage is pathognomonic of the disease when it is fully developed after ten or fifteen days. A raspberry like excrescence is extruded through the epidermis, its centre becoming capped with a yellowish crust and the edges everted (Fig 936). The specific organism (*S. pertenue*) may be found in the serous exudation beneath the crust, and in the juice of the adjacent lymph glands. In atypical cases, a syphilitic rash may be closely simulated. The rash slowly disappears, but may be present up to a year, and late secondary lesions may persist even after two years.



FIG 936—YAWS SECONDARY STAGE

The *Tertiary Stage* cannot always be recognized at first. Typical tertiary lesions are found on the hands and feet, in the bones and joints, in the naso-pharynx, and as extensive ulcerations in other parts of the body. In contrast to syphilis, vascular and visceral lesions are rare, and nervous lesions are doubtful. Some of the commoner types of tertiary manifestations are the following: Keratoderma, particularly of the hands and feet, associated with deep granulomata under the skin called 'crabs,' which produce very painful ulcerations and fissures, diffuse periostitis and osteitis, with areas of softened bone seen by X rays resulting in painful bony and joint deformities, more doubtful late para yaw changes comparable to the

tabetic and other parasymphilitic lesions of syphilis.

Three peculiar conditions believed by most authorities to be late yaws lesions remain to be described, these are gangosa, juxta articular nodules, and goundou.

Gangosa is a naso pharyngeal affection producing extensive destruction of the bones and soft tissues of the nose and palate, the larynx being usually spared. Progress is very slow, and arrest may take place even without treatment at any stage. This is the only type of yaws ulceration which involves mucous membranes.

Juxta-articular Nodules are now accepted as a tertiary manifestation of yaws involving the long bones in the neighbourhood of joints such

as the knees. They are not painful, but are likely to break down. If for any reason they are found to be inconvenient, they may be removed surgically.

Gonion is the name applied to symmetrical hard nodes which are found to be growing from the upper part of the nasal processes of the superior maxillæ, and the nasal bones, in individuals who may also have osseous elevations on the clavicle mandible, etc. They are believed to be tertiary yaws growths, and begin in childhood as sub-acute inflammatory elevations of the surface of the bones. Growth is very gradual, and if uninterrupted by treatment may produce unpleasant pressure effects by invasion of the cavities of the nose and orbits. The condition is most often seen in Central Africa and South America. The hyperostoses may be removed surgically, if necessary.

Diagnosis—A typical case of yaws can be diagnosed by the clinical features, but its resemblance to syphilis both bacteriologically and clinically must be kept in mind, especially as both diseases may occur at the same time. Yaws differs from syphilis in that there is no evidence of antenatal infection, the primary lesion is usually extra-genital, the eyes and mucous membranes are unaffected for the most part, the vascular and nervous systems usually escape, mercury has no specific action, treatment is much more rapidly efficacious.

Treatment—Although mercury is of little value against infection by *S. pertenue*, the salvarsan group of drugs and bismuth are markedly effective. One full injection of novarsenobillon may cure yaws in the primary or secondary stage, but it is safer to give three injections at weekly intervals. For the treatment of large numbers of individuals, sodium bismuth tartrate or bismuth metal has been found effective. In the case of an infected community, efforts must be unremitting in the direction of personal hygiene.

Boomerang Leg consists of an antero-posterior curvature of the leg below the knee, with the convexity forwards and is due to yaws. It occurs in Australian aborigines and has been called 'sabre tibia'. The actual deformity varies greatly, the situation of maximum deformity is either about or a little above the centre of the tibia. Radiographically, there is marked thickening of the compact bone in the region of the bowing. There is no disability in any but the very advanced cases, when the tibial muscles become weakened and fail to compensate the forward displacement of the centre of gravity. In old standing cases ulceration may occur over the thickened bowed portion of the tibia.

Leishmaniasis is an infection widespread in the tropics, and most of the clinical manifestations are of surgical importance. The following are some of these: Kala azar and dermal leishmanoid, Oriental sore, diffuse cutaneous leishmaniasis, espundia or naso-pharyngeal leishmaniasis. The Leishman Donovan body, the causative organism in this disease, is a rounded body 2 to 4 μ in length, with an oval tropho-nucleus and a smaller rod shaped rhizoplast. They may be found in very large numbers, mostly inside endothelial cells. The mode of infection has not been worked out very clearly, but this will be referred

to again. An interesting recent discovery is their presence in large numbers in some cases in the mucous membrane of the tonsils and naso-pharynx. When cultivated outside the body they assume the form of motile flagellates. The tropical fever kala azar is a generalized form but its surgical aspects must be described.



FIG 937—ORIENTAL SORE ON NOSE

Oriental Sore is also known by various other names such as Bagdad boil, Delhi boil, Biskra button etc. and as the names suggest this cutaneous form of leishmaniasis occurs in many of the hot and dry regions of the tropics. Oriental sore may be single or multiple, appearing chiefly on the face and extremities and is first seen as cutaneous nodules. After some days or weeks they become granulomatous and begin to break down into scabbed ulcers. Some extension may occur at the edges, but no great size is reached except by the coalescence of several sores (Fig 937). If untreated this chronic stage is maintained for several months after which slow healing occurs leaving an ugly and depressed scar. The leishmania parasite found in Oriental sores has been designated *L. tropica* and is morphologically indistinguishable from *L. donovani*. It is found in large numbers inside the large mononucleate cells which form part of the intense cellular exudation which occurs beneath the growing edge of the sore. The presence of ordinary septic organisms has the effect of driving the parasite into the deeper parts of the inflamed area. Experimental evidence favours the view that the ordinary mode of infection is by means of bites of sand flies such as *P. papatasi*; but there is evidence that direct transference of the organism is possible on abraded areas. Treatment is best effected by means of intravenous injection of one of the antimony derivatives. Sodium or potassium antimony tartrate is given up to a total of 20 to 30 grains in ten to twenty injections, healing is slow but steady. Fouadin is also recommended in doses of 0.5 to 5 c.c. A more rapid method of treatment is by berberine sulphate injections round the edges of the sore in 2 c.c. doses of a 1 per cent solution. When the sore is very septic the cure will be expedited by judicious scraping and cleansing. Various other local methods of eradication are practised such as by carbon dioxide snow, X-ray exposure, ionization etc. It is important to remember that



FIG 938—DERMAL LEISHMANIASIS RESEMBLING LEPROSY

the deeper areas are invaded by the parasites, which extend a good deal beyond the apparent edge of the sore

Diffuse Cutaneous Leishmaniasis differs in no essential respect from Oriental sore but it is convenient to describe the condition separately to draw attention to the fact that these lesions are of a diffuse character, and may slowly progress for years. They are more often met with in districts where moist heat prevails (Fig 937). Diagnosis must never be made on clinical appearances alone as the effects of secondary sepsis and partial attempts at cure may alter the character of the granulomatous area, so that ulcerative papillomatous and keloid types may result (Figs 938 and 939)

Espundia, or naso pharyngeal leishmaniasis is prevalent in many parts of the South American continent, and is a much more serious and destructive form of the disease. The causative organism is indistinguishable from *L. tropica* and has been named *L. braziliensis*

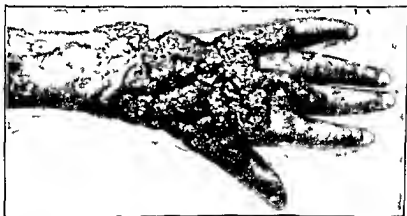


FIG 939.—DIFFUSE CUTANEOUS LEISHMANIASIS OF THE PAPILLOMATOUS TYPE

It is probable that the infection is carried by a phlebotomus, as in the case of Oriental sore. Clinically this disease begins as a sore on a mucous surface, and this gradually heals like an Oriental sore, but months or even years later secondary ulceration appears in the mouth or naso-pharynx. This results in a very serious destructive process resembling a gummatous ulceration, which gradually proves fatal if unchecked by treatment. Fortunately antimony has a specific action, and a course of 20 to 30 grains subcutaneously generally suffices, if local surgical cleansing is carried out and powdered antimony tartrate is applied to the ulcerated surface.

Tropical Granulomata.—The following are the more important granulomata met with in the tropics which merit a brief description

Granuloma Venereum is a distinct form of granuloma, believed to be acquired during sexual intercourse, which is well known in some tropical countries e.g. India, Southern China, Pacific Islands, West Africa, South America, North Australia. The aetiology of the disease

has not been satisfactorily worked out but it is probable that the body originally described by Donovan in 1905 is the responsible organism and recent work in Madras points to this being a capsulated bacillus. They occur in the large mononuclear cells. Pathological examination of the affected tissues shows numerous nodules made up of round cells near the edge of the ulceration with much overgrowth of the papillæ and interpapillary processes. The epidermis is altered and broken down in places while the normal connective tissue strands beneath the epidermis are replaced by inflammatory and plasma cells grouped around hair follicles. In healing areas fibrous tissue predominates. The *clinical features* of an established case seen months or years after infection present a characteristic picture. The disease is commoner in females and occurs after puberty and up to fifty years of age. The affected area in the inguinal region and adjacent parts is granular with glazed patches the edges are raised and have a circinate outline and in places healing is attempted under a cracked pigmented and scabbed surface. The usual history is that the disease began as a small papule which appeared a few days after sexual intercourse. Contiguous surfaces between the scrotum and thigh or scrotum and penneum are commonly involved. Diagnosis is usually made from the characteristic appearance and clinical history but histological examination may be necessary to exclude lupus or epidermoid cancer. *Treatment* is not always satisfactory. Foul granulations should be cleaned up by scraping and antiseptic compresses. Injections of tartar emetic if persisted in are generally efficacious and X-ray exposure will hasten recovery. Recurrence is to be expected unless all parts of the ulcerated areas are patiently dealt with.

Inguinal Lymphogranuloma (Poradenitis venerea, Chumato Budo) is a very chronic type of venereal lymphadenitis which most commonly occurs in the Malay States, China and Japan and more rarely in other parts of Asia, Europe and America. A history is generally obtained of an infected abrasion discovered after sexual intercourse. A flood of light has been cast on this and kindred affections such as genito-ano-rectal ulceration and stricture in both sexes and the elephantoid ulcerating condition named esthiomene in the female by the recent discovery that they are all due to the same ultra microscopic virus. This was made possible by the introduction of the Frei intradermal test carried out by injecting a saline solution of sterile pus obtained from an infected area. This discovery has opened up a new chapter not only in tropical surgery but also in that of temperate climes. Those who wish to pursue the subject further are referred to the interesting monograph on the subject by Hugh Stannus entitled *A Sixth Venereal Disease*. The characteristic feature of this infection is that it has an intense affinity for the lymph glands unlike granuloma venereum which attacks the epidermis and dermal tissues only. The *prominent clinical features* are subacute inguinal lymphadenitis persisting for weeks or months accompanied by irregular fever and usually resulting in breaking down of the affected glands with ulceration of the neighbouring tissues and skin (Fig. 940). In the female the primary venereal sore often occurs in the region of the fourchette.

and the lymph glands involved are those in the pelvis particularly those close to the rectum. Very intractable inflammation may follow and in the later stages stricture of the rectum and elephantoid enlargement of the labia with ulceration. The inguinal glands may also be affected as in the male subject. No evidence is available to connect the disease with the ordinary venereal infections. Treatment in the past has been by surgical excision and in less severe cases by intravenous injections of tartar emetic or iodine. In recent years striking results have been obtained by protein therapy. Intravenous injections of a T A B vaccine were first used for this purpose a first injection of 100 millions with an increase of 50 millions per dose at intervals of four or five days up to 500 million dead organisms. Intravenous injections of various antimony preparations such as neostibosan and stibenyl, have also been used with good results. Locally, surgical cleansing is essential fistulous tracks being opened up where necessary.

Diffuse Spirochætal Papillomatosis has been described particularly in Egypt by Madden, as a definite clinical entity. This is to be considered as distinct from secondary spirochætal infections of chronic bilharzial or other ulcerations. Primary spirochætosis of this type may involve the lips (*granuloma labiale*) and also other muco-cutaneous areas. The disease



FIG 940.—INGUINAL LYMPHOGRANULOMA

may assume a granulomatous or ulcerative character, closely resembling epidermoid carcinoma. When left untreated, the tissues are steadily destroyed. Diagnosis may be effected by examination of histological sections stained for spirochætes, and the specific action of salvarsan and its derivatives will afford further evidence in this direction.

Granulomata caused by Pathogenic Fungi are well known in hot countries, and some of the more important of these are discussed below.

Actinomyces is a streptothrix infection which is not very uncommon in temperate zones, and has already been referred to on p 190. In the tropics it very rarely attacks the jaw, but infection of the skin and subcutaneous tissues, lung and pleura, liver and intestinal tract may be observed (Fig 941). When the appendix or ileo-cæcal region is involved, the symptoms closely resemble those

of chronic dysentery In later stages a mass may become obvious simulating a new growth or tuberculous invasion Details of pathology and treatment are dealt with on p 197

Mycetoma is another fungous disease found in many parts of India, and may be met with in any hot country The specific organisms have been variously classified but the various groups need not be described here The subcutaneous tissues particularly of the feet are most often attacked but in some forms such as the actinomycotic variety, the internal organs may also be involved *Clinically*, mycetoma usually begins as a chronic affection of one foot, resulting in the formation of one or more painless nodules Extension slowly occurs, accompanied by breaking down and a viscid discharge results which often contains black, yellow, or red granules Pain becomes a prominent feature as the deeper tissues are involved and a shapeless foot with unequally retracted toes and many sinuses in various stages of



FIG 941—ACTINOMYCOSIS OF BACK

activity is the outcome of the disease *Pathological examination* of an affected foot or hand reveals areas of softening in which the mycelium and spore-like bodies are found alternating with areas of very dense fibrosis All tissues down to and even including the bones are ruthlessly destroyed the tendons and nerves surviving the longest (Fig 942) The adjacent lymphatic glands may be involved by secondary infection or by actual extension of the fungus *Treatment* is very unsatisfactory in the absence of any specific drug Amputation is often necessary to free the patient from a painful and useless member Short of this drastic treatment the only procedure which has been found efficacious to allay the constant pain is multiple diathermic puncture, the needle being pressed bone-deep into painful areas

Blastomycosis is a fungous disease due to infection of the skin and subcutaneous tissues by a yeast like fungus (*saccharomyces*) A chronic dermatitis of the buttock perineum or axilla may be due to

this cause. The *clinical features* do not always conform to a single type, and the history is not easily obtained owing to the gradual onset and chronic character of the affection. The skin and cellular tissues become involved in a *granulomatous lesion* active in some parts and scabbed or keloid in others (Fig 943). There is often a foul discharge due to mixed infection and necrosis of skin and subjacent tissues. More serious types of the disease are known where mucous membranes are involved e.g. *lingua nigra* and systemic infection may occur with fatal results owing to extension to the lungs, liver and other viscera. The term 'gummomycosis' has been given to chaulical types and gumma



FIG 942—MISCEOMA OR MADURA FOOT
(Courtesy of Dr Jones and Dr Alden)

like characteristics. The *diagnosis* can only be presumptive unless confirmed by bacteriological examination of smears or pieces of the affected tissues. It is easy to identify the yeast like organism in most cases but the possibility of casual secondary infection by fungi must be borne in mind. Agglutination and complement deviation tests have been usefully employed. *Treatment* is not very satisfactory. The affected area should be thoroughly cleansed by hot antiseptic compresses, and foul patches excised or scraped. Large doses of potassium iodide are generally beneficial and X ray exposure will hasten healing. Recovery is usually very slow, owing to the chronic nature of the disease.

Rhinosporidiosis is another granulomatous condition due to a yeast-like fungus *Rhinosporidium seebertii*, which is met with in many parts



FIG 943 — EARLY CASE OF
BLASTOMYCOSIS

of the tropics, and produces chronic lesions of the nose, eye, urethra, and other mucous surfaces. The parasite was first described in the Argentine and was discovered independently in Calcutta by Vaughan in 1894 and described by O'Keefe. It is considered to be a phycmycete. The affected tissue becomes riddled with minute cysts 0.25 to 3 mm in diameter each of these becomes filled with daughter spores which escape when mature and involve the surrounding parts and lymphatics. Clinically a granulomatous polypoidal, or ulcerating area is noticed most commonly in the anterior part of the nasal mucosa producing a strawberry like appearance. Growth is quite slow, and local excision or destruction by

the cautery can be readily effected where the disease is not advanced. In more accessible places and when larger areas are involved injection of tartar emetic in ordinary doses has a specific action.

Rhinoscleroma is a progressive granulomatous condition generally involving the nose, palate, pharynx or larynx. It has a wide distribution over India, Sumatra, Brazil, South and East Europe and Egypt so that it is by no means confined to tropical lands. Firm and nodular swellings in the skin or mucous membranes are characteristic of the disease and its slow but persistent growth is not usually arrested except by thorough excision. The aetiology has not been satisfactorily worked out but the causative organism has been identified as a bacillus (*B. rhinoscleromatis*) which resembles Friedländer's pneumo-bacillus in its physical characters. Exaggerated and neglected cases are met with in the tropics in which overgrowth or ulceration has caused deformity (Fig 944) and it is probable that in such cases as the hippopotamus man a secondary sarcomatous change has occurred. The granulation masses consist of firm connective tissue,



FIG 944 — RHINOSCLEROMA
LATE CASE

with hyaline masses or collections of vacuolated cells, containing the specific bacilli. *Treatment* is very unsatisfactory, unless total excision is possible. X ray radiation is beneficial after the accessible nodules have been removed surgically.

Surgical Complications of Tropical Fevers—Most of the acute specific fevers prevalent in temperate countries, and their surgical complications, are well known in the tropics. We have to keep in mind, however, the surgical aspects of various fevers which are peculiar to hot countries. Among the most important of these are the following: Malaria, dengue and sandfly fever, human trypanosomiasis, kala azar, rat bite fever, oroya fever and verruga peruana, undulant fever and fevers of the enteric group. It is not possible to describe in detail the surgical complications of these fevers, but the most important will be enumerated.

Malaria—Hæmorrhages from mucous membranes and post-operative bleeding, increased liability to septic complications, enlargement of the spleen, with liability to rupture or torsion of an elongated pedicle, splenic disease due to necrotic degeneration, peripheral neuritis and neuralgia, visceral complications of malignant tertian malaria, such as cerebral lesions, producing irritative or paralytic signs, abdominal lesions causing symptoms simulating appendicitis, cholecystitis, etc., hæmoglobinuria due to blackwater fever.

Dengue and Sandfly Fever are both short and very acute fevers, which may seriously complicate surgical cases and even cause death by hyperpyrexia. Dengue may produce arthritic sequelæ of varying severity, but seldom resulting in suppuration.

Human Trypanosomiasis exists in three well known types, of which two are African, and caused by *T. gambiense* and *T. rhodesiense* respectively, and one is South American caused by *T. cruzi* (Chagas' disease). The surgeon may be consulted in *T. gambiense* infections for various skin eruptions, for inflammatory signs, such as lymphadenitis, orchitis, periostitis, and eye affections, for nervous symptoms, including neuralgias, paralyses, or convulsions, pointing to a lesion of the central nervous system. *T. rhodesiense* infections run a much acuter course, marked by considerable glandular enlargements. Chagas' disease attacks young infants in Brazil and Venezuela. In addition to fever and general anasarca, there is enlargement of the thyroid and lymphatic glands, and of the spleen and liver, the central nervous system is involved in the terminal stages.

Kala-Azar is an acute or chronic fever, due to infection by *Leishmania donovani*. The greatly enlarged spleen found in this disease is not amenable to surgical treatment, but various other surgical complications may occur. Hæmorrhages from various mucous membranes are a feature of the disease, and the increased liability to post-operative bleeding must be kept in mind. Gradual and painless enlargement of the lymph glands of the neck, axilla, or groin is common, and the specific organism is found in fluid extracted from such glands. Septic complications are sometimes very serious, and in the mouth may terminate in gangrene, producing the condition known as 'cancrum

oris,' or in other parts of the body may result in 'noma,' otitis media, ischio-rectal abscess, or gangrene, etc.

Rat-Bite Fever is caused by infection with *Spirillum minus* from the bite of a rat, after about ten days' incubation. A relapsing fever results, associated with signs of acute inflammation about the wound. The condition is important surgically, because it is by no means uncommon, and it is often mistaken for cellulitis due to ordinary secondary infection. Appreciation of its aetiology will enable prompt treatment to be carried out by means of intravenous injections of novarsenobillon.

Oroya Fever and Verruga Peruana.—The former, known also as Carrion's disease, is an acute fever occurring in Peru and certain valleys of the Andes. It produces rapid emaciation and severe anaemia of the pernicious type. Closely associated with this fever is a granulomatous condition known as verruga peruana, which is now believed to be due to infection by a specific organism, *Bartonella bacilliformis*, common to both conditions. The eruption resembles that of yaws, except that mucous membranes are also affected and some of the individual granulomas may become large and pedunculated, and, being cavernous in structure, may cause dangerous bleeding. No specific treatment is known, but surgical excision or diathermy must be resorted to for serious hæmorrhage from accessible areas.

Undulant Fever, or Malta Fever, is by no means confined to tropical countries, but among its many complications there are some which the surgeon will be called upon to treat, and when these occur during periods of remission or of low fever, a suspicion of malaria or rheumatism may be aroused and the true diagnosis missed. Various types of inflammatory disturbance occur, such as orchitis, parotitis, mastitis, boils and abscesses, neuralgias and chorea, transient arthritis affecting one or more joints, phlebitis, and mucous hæmorrhages.

Fevers of the Enteric Group.—The surgical complications of this group of infections are well known in temperate countries, and a reference to an authoritative book on the subject* reveals a list of twenty-eight such complications which may occur during the course of typhoid and paratyphoid fever alone. In hot countries the enteric fevers are more prevalent, and it is the experience of most practitioners that the disease runs a more severe course, and the liability to serious complications is much increased. *Bacillus coli* and other bowel organisms, such as *B. faecalis alkaligenes*, are also to be remembered in this connection. A very fatal form of multiple liver abscesses is well known to be due to *B. coli*, as also infection of the urinary tract, causing pyelitis and cystitis. Appendicitis and cholecystitis, otitis media, arthritis, tonsillitis abscesses, and boils are a few of the important surgical complications which may occur, and in some instances lead to septicaemia. Infection is carried from the bowel in post typhoid and post-dysenteric cases through abrasions of the intestinal mucosa, or as a result of greatly lowered resistance.

The aetiology and treatment of the various tropical fevers which have been mentioned above must be carefully studied in books on tropical

* Surgical Aspects of Typhoid and Paratyphoid Fevers. (Webb-Johnson)

medicine, if the surgical complications for which they are responsible are to be dealt with properly. Kala-azar, for instance, can now be most efficiently treated by tartar emetic and various other organic antimony compounds, such as neo stibosan (No 693). Specific treatment, where possible, is obviously the first essential when treating surgical complications.

It is convenient to summarize here the tropical fevers which are responsible for the production of two important surgical signs namely lymphadenitis and jaundice. Acute lymphadenitis, generally close to the area of primary infection, occurs in plague and rat bite fever. Filarial enlargements of lymph glands are of various types, and are usually associated with other filarial signs, in climatic bubo the glands are subacutely inflamed, and may slowly break down, and, lastly, in trypanosomias and kala azar there is painless enlargement of glands in the posterior triangles of the neck. Jaundice of hæmolytic origin is found in the following fevers. Subtertian malaria and blackwater fever, relapsing fever, and in Weil's disease and yellow fever. Obstructive jaundice has been noted in undulant fever, due to the pressure of lymphatic glands at the hilum of the liver, and in amoebic liver abscess.

Surgical Aspects of Dysentery in the Tropics.—The surgical treatment of the dysenteries and their surgical complications are of great importance in tropical countries. All types of dysentery are much more common, and certain varieties are met with which are little known in cold countries. We have to consider here the following important dysenteries. Amoebic Dysentery, caused by *Entamoeba histolytica*, and other less important protozoal bowel lesions due to *Balantidium coli*, *Leishmania donovani*, *Lambia intestinalis*. Bacillary Dysentery, caused by *B. dysenteriae*. Dysenteric symptoms may be caused by *Schistosoma mansoni*, *S. japonicum* and *S. hæmatobium* (Shiga and Flexner group), and by other helminths in rarer instances. Ulcerative Proctitis, or Colitis, due to various infections, often mixed, and not infrequently secondary to amoebic or bacillary dysentery.

The Surgical Aspects of Amoebic Dysentery are very important, as *E. histolytica* may travel to any part of the body and produce pathogenic effects. The term 'amoebiasis' is applied to such infections. The life history of the parasite and the pathology of its invasion of human tissues cannot be described here. Suffice it to say that pathogenic amoebæ can be seen in microscopic sections to advance in the forefront of bowel lesions until they reach the deep lymphatic spaces and enter portal radicles, and thus their spread to neighbouring tissues and to distant organs, such as the liver, is not difficult to understand. The surgical complications which follow may be considered according to the effects produced in the bowel, in contiguous tissues, and in distant organs.

Amoebic Ulceration of the Bowel may result in hæmorrhage and perforation, acute or chronic localized colitis, producing conditions resembling appendicitis or even gangrene of the bowel wall, fibrous thickenings and adhesions, carcinoma, intussusception, diverticulitis,

periproctitis and fistula in ano, hemorrhoids and polypi. Extension of the amœbic infection to neighbouring parts may result in acute or chronic peritonitis, pericæcal or pericolic inflammation or abscess, or similar processes involving the perirenal or periproctal tissues. The invasion of more distant organs and tissues is of even greater importance in tropical surgery, especially as regards the effects on the liver by extension along the portal routes. Complications which may be thus produced include hepatitis and hepatic abscesses, cholecystitis, invasion of the pleura and lung, splenic and renal abscess, cerebral abscess, cystitis and epididymitis, cirrhosis and lymphadenitis. Space forbids a full description of these numerous complications, but a brief account of hepatitis and liver abscess is essential.

Amœbic Hepatitis and Liver Abscess may occur during any stage of the bowel infection, and even in cases where there is no clinical evidence of dysentery, so that the surgeon in the tropics must always keep in mind the possibility of this occurrence. The presence of amœbæ between the liver cells causes inflammation and later necrosis of liver tissue, but it is usually impossible to ascertain at what stage an actual abscess has begun to form. In considering the *clinical features* of acute amœbic hepatitis and liver abscess certain predisposing factors must be kept in mind, such as race, sex, age, and various causes which lower the local powers of resistance, particularly alcohol. Infection of the liver is commonest among males between the ages of twenty and forty, and in low lying and humid localities. The onset of acute hepatitis is characterized by severe pain and tenderness over the liver, with some enlargement of that organ, remittent fever, and high leucocytosis; there is always a favourable response to emetine. Examination with the X-ray screen shows some displacement upwards, with little or no excursion. The attack may begin with a rigor, and chills are complained of; the tongue is furred; there is sweating and sometimes jaundice. The development of an abscess is associated with all or most of the above-mentioned signs, and in addition other signs may be noticed, viz. pain referred to the right shoulder, rigidity of the upper segment of the right or left rectus, inflammatory signs at the base of the right lung due to localized pleurisy or œdema, and fluctuation or actual evidence of a pointing abscess may be present. A tropical liver abscess is most often situated in the upper and back part of the right lobe, and in over 75 per cent of cases is solitary. Typical liver pus is of a chocolate colour, but in old cases it may be dirty white or muddy. In over 90 per cent of cases *E. histolytica* is the only organism present, microscopically red cells, leucocytes and liver debris are found, and amœbæ are only present in the abscess wall or in thick debris. Extension of a liver abscess may occur in various directions. Abscesses of the right lobe most often involve the base of the corresponding lung, while on the left side the pus generally points forward in the epigastrium or it involves one of the surrounding organs. Resolution or encystment may occur spontaneously, but usually this is the result of specific treatment. *Treatment* of acute amœbic hepatitis has been revolutionized by the introduction of emetine hydrochloride. Intramuscular injections of $\frac{1}{2}$ to 1 grain are given daily up to a total of ten or twelve doses. This

drug has also by its amoebicidal effect a specific action on the bowel lesions, but in obstinate cases other drugs such as emetine periodide or yatren, may be tried. Clinical experience has proved that these methods of treatment may also be efficacious in cases of established liver abscess, but it is unwise for the surgeon to rely on them entirely, and when pus is suspected or proved to exist it is necessary to arrange for its evacuation. Aspiration is by far the best method to adopt for this purpose, as an open operation introduces the grave risk of mixed infection. A spot is selected in the anterior axillary line in the eighth or ninth space, and an exploring needle 3 to 3½ inches in length and No 9 bore (metric gauge) is inserted up to a depth of about 3 inches in an inward, backward and slightly upward direction. If pus is discovered by suction on the first or succeeding punctures, it is better to introduce a larger cannula (No 16) along the same track, so as to evacuate the cavity as completely as possible, and to remove the fibrinous sloughs which are nearly always present. The cannula is then withdrawn, a stitch inserted to close the small skin opening, and a firm bandage applied over the dressing. A second or third aspiration may be necessary if the cavity refills, but if very definite progress is not made after successive evacuations, arrangements must be made to drain the cavity through the aspiration tube or by open operation.

Treatment by open operation is necessary under certain conditions, e.g., for anterior abscesses of the right or left lobe, for multiple abscesses, for deep-seated abscesses such as those occurring in the Spiegelian or quadrate lobes, or of the suprahepatic or perihepatic variety, and for cases of mixed infection. Such operations are generally carried out by the epigastric route, the lateral transpleural route, or by the posterior route. The mortality of amoebic abscesses has been very greatly reduced during recent years by the introduction of emetine and the aspiration method of treatment, for which we are indebted to the work of Sir Leonard Rogers in Calcutta. It is only in cases of exceptional severity, in neglected or undiagnosed cases, and in cases of multiple abscesses, that a fatal result is likely to occur.

The Surgical Complications of Bacillary Dysentery are also very numerous, but need not be discussed here at any great length. The bowel itself may suffer in the following ways. Haemorrhage and perforation, localized sloughing or gangrene, cæcitis or appendicitis, abscesses and sinuses in the mucous membrane, hæmorrhoids and polyp, fibrous thickenings, stricture and adhesion to adjacent structures, diverticulitis, intussusception, carcinoma. Extension of the inflammatory process to neighbouring tissues is not nearly as likely to occur as in the case of amoebic dysentery, but localized or general peritonitis may follow a leak in the bowel, and various complications result from burrowing abscesses. Secondary complications due to infection of distant parts by the specific organism, or some other organism introduced through dysenteric lesions, are important. The liver is not picked out in the same way as in amoebic disease, but very severe infection may occur, resulting in pylephlebitis or multiple abscesses and pyæmia. Cirrhosis of the liver is a later complication. Other well-

known sequelæ are conjunctivitis and iritis cysto-pyelitis urethritis and arthritis

The arthritis which follows attacks of bacillary dysentery has been recognized from ancient times. This may take the form of a polyarthritis or a single joint may be involved the knee the ankle elbow hand shoulder and wrist represent the order of frequency of involvement. It is generally in the later stages of the disease that the complication occurs and this is another instance of infection being carried to distant parts from the infected bowel. Joint affections occur in about 1 per cent of cases and are more common in some epidemics than in others. The severity of the attack varies from a mild disturbance without effusion to severe arthritis involving ligaments and cartilage with a liability to false ankylosis or deformity.

Surgical aid may be required in dysenteries of any type when ordinary medical treatment is incapable of arresting the course of the disease. Delay is most unfortunate in such cases and a definite line of surgical treatment should be decided upon before the decline in health has progressed too far. *Appendicostomy* is a simple operation in most cases and it is useful in relapsing cases of the severest type it provides a means for thorough lavage of the large bowel but does not give complete rest to the part. *Cæcostomy* is useful in the worst cases where free drainage is necessary as well as functional rest the valvular form is available if the patient can stand a longer operation. *Ileostomy* with an open cæcostomy and *ileo-sigmoidostomy* may be advisable in selected cases when a skilful surgeon is at hand.

The Surgical Affections caused by Parasitic Worms in the tropics are very numerous and two groups are especially worthy of close attention namely schistosomiasis and filariasis. Paragonimiasis clonorchiasis and the surgical complications caused by intestinal and other parasitic worms cannot be discussed here.

Schistosomiasis is caused by infection with trematodes which live as parasites in the circulatory system during their definitive stage. They are responsible for diseases of the urinary or intestinal tracts which result in a great variety of surgical lesions. They are well known in Africa Mesopotamia Persia South America the West Indies and the Far East. The intermediate hosts are fresh water snails which are curiously absent from India. The ova hatch out in water releasing free swimming embryos or miracidia which enter the bodies of the snails. After undergoing changes of structure they emerge as bird tail cercariæ which are capable of penetrating the skin of a suitable vertebrate to initiate a fresh infection.

Bilharziasis or Endemic Haematuria is the disease caused by *S. latiorium* in Africa Mesopotamia Persia and adjacent countries. In some parts of Egypt it is probable that no individual escapes infection. Toxic symptoms may appear a few weeks after the entrance of the parasites and the various signs characteristic of the disease begin to appear within a few months up to two or three years. The parasites inhabit the portal circulation particularly the pelvic plexuses and the inflammatory lesions which involve the urinary bladder rectum and occasionally the lungs are due to the deposit of great numbers of

terminally spined ova in the submucosa and mucosa. Cystitis may be succeeded by ascending urinary infection and this, together with rectal ulceration, produces abscesses, calculi, fistulae, polypi, and even secondary carcinoma. In later stages grave anaemia, emaciation, and exhaustion set in. The characteristic ova are found in the urine and pathological discharges.

Intestinal Schistosomiasis is of two types: that due to *S. mansoni* in Africa, South America and the West Indies, and the type found in the Far East, named *S. japonicum*. The adult parasites of *S. mansoni* live in the liver and mesentery, and the lateral spined ova are found chiefly in the polypoidal masses and ulcerations of the rectal mucosa. The transverse and pelvic colon may be similarly affected, and infection of the liver occurs in the later stages resulting in splenomegaly, cirrhosis, and ascites (Egyptian splenomegaly). *S. japonicum* causes an intestinal affection known as Katayama disease in China, Japan, and the neighbouring Pacific Islands. The ova of *S. japonicum* are without a spine, and are found in the abdominal organs, producing dysentery-like symptoms, ascites, anaemia, and emaciation; the liver and spleen are markedly affected in this disease. **Treatment**—The diseases caused by schistosomes can now be effectually controlled by means of a specific drug. Christopherson has proved in Egypt that intravenous injections of tartar emetic can kill the parasites. Doses of $\frac{1}{2}$ grain in 6 to 10 c.c. of sterile salt solution are injected on alternate days, $\frac{1}{2}$ grain being added to each dose up to a maximum of $2\frac{1}{2}$ grains per dose. The course extends over four to five weeks without interruption. It is important to begin the treatment as early as possible, before surgical and other complications have become established.

Filariasis.—Filarial worms provide an enormous amount of surgical work in some parts of the tropics. *Filaria bancrofti* (*Wuchereria bancrofti*) and *Dracunculus medienensis* being the chief offenders, while two others are worthy of mention, namely, *Loa loa* and *Onchocerca volvulus*.

Filaria bancrofti is widely distributed in large areas of the tropical and subtropical world, Southern Europe, South America, Pacific Islands, Northern Australia, South China, India, Arabia, and Africa. Millions of human beings are affected, and a large proportion are incapacitated to some extent by the pathological lesions which follow. The female worm is 0.25 mm. in breadth and 50 to 100 mm. in length, and inhabits the lymphatic vessels and glands. The embryo filariae, called *Microfilaria bancrofti*, are given birth to in these situations as microscopic objects, 0.3 mm. in length by 0.006 mm. in width, and find their way to the blood stream, whence they may escape by the help of various kinds of mosquitoes which act as intermediate hosts. After undergoing a transitional stage in the body of the mosquito during a period of twelve to twenty days, the metamorphosed embryos are found in the proboscis of their intermediate host ready for transfer to a new human host. This is the means by which a new cycle is started of young adults of both sexes.

Microfilaria bancrofti is a minute worm-like creature, with one end rounded and the other tapering to a point, and it is enclosed in a loose sac or sheath in which it can move freely, but which prevents inde-

pendent locomotion. *Microfilariae* occur in countless numbers in the circulating blood of infected individuals in cases where the maternal nidus is not shut off from the general circulation by inflammatory changes in the lymphatics. Their appearance in the peripheral circulation observes a curious periodicity in most parts of the world, being confined to the night hours. This was first described by Manson in 1880 and is called 'filarial periodicity'.

The Surgical Aspects of *F. bancrofti* Infections.—The surgical lesions which are met with in filariasis are of two sorts: those which are believed to be due to the reaction of the tissues to the filarial parasite itself or its toxin, and those which are due to secondary infection. It is probable that in most cases both causes are at work at the same time, or are conjointly responsible for the disabilities which follow. The following is an enumeration of the most important surgical manifestations: *Filarial fever*, which may occur in association with other obvious surgical lesions or independently; *lymphangitis*, *cellulitis*, *abscess*, *gangrene*, *funiculitis*, *orchitis*, *acute and chronic hydrocele*, *synovitis*, *arthritis*, *abscess of joints*, *lymphatic varices*, *lymph fistulae*, *gland varices*, *lymph scrotum*, *Chyluria* and *chylous effusions into the peritoneum*, *tunica vaginalis*, *pleura*, etc. *Elephantiasis of the legs*, *scrotum*, *mammary*, *vulva*, or *skin*.

The pathology of filariasis has not been fully worked out. All the evidence points to the young adult and the mature parasites as the disturbing factors, and the fact that they produce obstruction of lymphatic channels with dilatation due to back pressure. The inflammatory reaction is probably due to a combination of causes, namely, mechanical and toxic irritation, together with secondary infection from some septic focus in the body. Some important work has been done recently on this subject to prove that a condition of 'lataphylaxia' exists in or near the affected areas, resulting in a breakdown in the local cell-defence mechanism.

Filarial fever and the inflammatory outbursts generally occur at definitely periodic intervals, probably associated with the outpouring of embryos from the gravid female or some other event in the life-history of the parasite resulting in the release of toxins. When these attacks are of an erysipelatoid character, it is not unusual to find streptococci in the sodden tissues. In severe attacks cellulitis, followed by abscesses or gangrene may follow and require active surgical treatment, the scrotum and lower extremities are most often involved. A very serious condition, termed *funiculitis* or septic phlebitis of the spermatic cord is associated with filarial disease. It is a streptococcal infection which rapidly spreads down to the testis, and upwards along the cord. The inflammation is of sudden onset, and is accompanied by high fever, great pain, and acute tenderness. Urgent surgical treatment by laying open the affected tissues is necessary, or castration in more advanced cases. If treatment is delayed, there is grave danger of pyæmia and a fatal issue.

Inflammation of the testis and epididymis are common occurrences in filarial subjects. The attacks are usually of a subacute type, and may be accompanied by hydrocele. Suppuration is not common except in the more severe types, in which a chylous effusion may be found

swarming with microfilariae. The typical tropical hydrocele is probably not filarial. It is very common in some hot and moist districts and is due to a subacute form of epididymitis the etiology of which has not been worked out. All forms of hydrocele except in the acute stage are treated by open operation with eversion of the sac. When the sac is very large or much thickened partial removal is necessary.

Lymphatic obstruction of dependent parts and of lymphatic glands and in the thoracic duct system are among the most characteristic signs of filarial disease. Extreme instances of this are lymphatic varices which may rupture and produce lymph fistulae, gland varices and lymph scrotum are also met with. Localized lymphangiectases and conditions such as lymph scrotum may usually be removed surgically



FIG. 145.—FILARIAL ELEPHANTIASIS OF THE SCROTUM

with advantage. The chylous effusions are only a stage farther in this process of obstruction the thoracic duct being involved in these cases. Treatment is most unsatisfactory and during periodic exacerbations the patient may suffer severely in general health.

Surgery is most useful in dealing with the well known elephantoid enlargement of dependent parts such as the legs, scrotum, arms, mammae, vulva and skin. The unfortunate victims may be confined to their beds by the weight of the tumour and few operations in surgery produce a more dramatic effect than the restoration of a patient to active life by the removal of a scrotal tumour weighing fifty or more pounds (Figs. 945 and 946).

Nothing is more efficacious in very early cases of filarial thickening

than the removal of the patient to a cooler and non-filarial climate. Much improvement can also be effected by rest and pressure bandages, but such methods are not available for the working classes. In the case of the lower extremities, masses of solid œdema, with or without papillomatous excrescences, can be removed and replaced by thick skin grafts. Kondoleon's operation is also practised, it consists essentially of the removal of large longitudinal strips of thickened tissue, including deep fascia, so as to open up the deep lymphatic spaces. Amputation is sometimes necessary when a leg has become riddled with abscesses and sinuses.

The operation for elephantiasis scroti consists in the removal of all the diseased skin and œdematous tissue after isolating the penis and



FIG 946.—FILARIAL ELEPHANTIASIS OF SCROTUM AND PENIS.

testicles. The raw penis is covered with a skin graft, and the testicles covered by the narrow perineal flaps or buried in pouches prepared under the superficial fascia at the junction of the perineum and thigh.

Elephantiasis of the arms, mammae, vulva, scalp, skin, etc., may be treated by surgical excision and skin grafting in a similar manner.

It will be observed that no effective specific treatment for filarial disease has yet been evolved. It is probable that one reason why anthelmintic drugs are useless is that the adult filariæ live for the most part in deep lymphatic vessels and glands, unlike bilharzia worms.

Loiasis is not of great importance. The parasite is found in large

areas of tropical West Africa. The intermediate host is a day biting fly named *Chrysops*. Surgically the most important lesions found are the transient inflammatory swellings termed Calabar swellings. These may appear in the neighbourhood of the eye, under the skin of the penis, on the hands, chest, etc. They are not painful and disappear in two or three days, being due to the irritation produced by the worms or their embryos.

Onchocerciasis is another filarial infection of minor importance found in Central Africa, the Gold Coast and other places. Fibrous tumours are produced by the irritation of the worms in the axillæ, popliteal spaces and other areas rich in large lymphatics. Surgical removal is practised when the tumours become inflamed or cause inconvenience.

Dracontiasis, or Guinea-Worm Disease, is found in India and other tropical countries and is responsible for much suffering and disability.

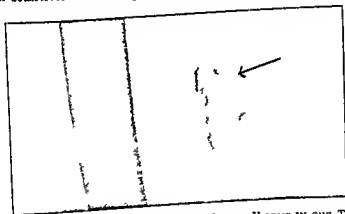


FIG. 947.—CALCIFIED REMAINS OF DEAD GUINEA WORMS IN THE THIGH CAUSING SCIATICA.

The guinea worm (*Dracunculus medinensis*) infects man as the definitive host and is conveyed by drinking contaminated water in which the embryos are found inside their intermediate host *Cyclops*, the water flea. The female, when fully developed in the human subcutaneous tissues, reaches a length of 30 cm. to 1 metre and 0.5 to 1.5 mm. in width. The male is seldom seen and is said to be only 22 mm. in length. In parts of India infested by this worm the rate of infestation is as high as 30 per cent. The female reaches maturity in about a year and in about 80 per cent of cases develops in the subcutaneous tissues of the lower extremities, but any part of the human body may be affected. The emergence of the head, alongside which is the opening of the uterine sac, is made possible by local necrosis of tissue caused by a helminthic poison, and when this gives way a stream of embryos is exuded by the worm when the part is brought into contact with water. Various vasomotor symptoms may appear at this time, such as giddiness and vomiting. Septic infection of the necrotic tissue is very

common resulting in cellulitis and abscesses. Trouble may also follow from death of the worm in the tissues and late sequelæ caused by the calcified remains of dead parasites may produce symptoms of sciatica arthritis etc (Figs 947 and 948). *Treatment*—Removal of the worm may be carried out by daily traction by surgical excision, or by de-



FIG 948—CALCIFIED GUINEA WORMS CAUSING SYNOVITIS OF KNEE JOINT

struction of the worm by the injection of various antiseptic fluids. Septic complications must be treated.

The reader is referred to books on tropical surgery and tropical medicine for a fuller account of the special aspects of surgery as practised in the tropics only the more important diseases and conditions have been referred to in this short chapter. It has not been found possible also to discuss here the effects of tropical conditions of race and climate on ordinary surgical affections common to the tropics and other parts of the world.

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